VOLUME I

TRANSCRIPT OF RECORD

Supreme Court of the United States

OCTOBER TERM, 1960

No. 315

POWER REACTOR DEVELOPMENT COMPANY,
PETITIONER,

vs.

INTERNATIONAL UNION OF ELECTRICAL, RADIO
AND MACHINE WORKERS, AFL-CIO, ET AL.

No. 454

UNITED STATES, ET AL., PETITIONERS,

vs.

INTERNATIONAL UNION OF ELECTRICAL, RADIO
AND MACHINE WORKERS, AFL-CIO, ET AL.

ON WRITS OF CERTIORARI TO THE UNITED STATES
COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

NO. 315 PETITION FOR CERTIORARI FILED AUGUST 12, 1960

NO. 454 PETITION FOR CERTIORARI FILED SEPTEMBER 29, 1960

CERTIORARI GRANTED NOVEMBER 14, 1960

VOLUME I—JOINT APPENDIX

IN THE

United States Court of Appeals

FOR THE DISTRICT OF COLUMBIA CIRCUIT

No. 15,271.

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL-CIO; UNITED AUTOMOBILE, AIRCRAFT AND AGRICULTURAL IMPLEMENT WORKERS OF AMERICA; and UNITED PAPERMAKERS AND PAPERWORKERS,

Petitioners,

v.

UNITED STATES OF AMERICA, and ATOMIC ENERGY COMMISSION,

Respondents,

POWER REACTOR DEVELOPMENT COMPANY and STATE OF MICHIGAN,

Intervenors.

ON PETITION TO REVIEW AND SET ASIDE AN ORDER OF THE ATOMIC ENERGY COMMISSION

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Oral Testimony Taken Before the Hearing Examiner

ERNEST R. ACKER

* * *

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Direct Examination by Mr. Reid

Q. Mr. Acker, on pages 7 to 8 of your testimony you stated that the public utility companies that contribute to PRDC have assets in excess of $2 billion. Do you wish to add to or correct this statement? A. There was an omission there, Mr. Reid. It should have stated that the utility member, companies and contributors of PRDC have combined assets in excess of $6 billion and that their total equity amounts to in excess of $2 billion.

* * *

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Q. Mr. Acker, have you had prepared a revised statement of source and application of cash during the operating

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period 1961 to 1970 which reflects these changes in processing costs? A. Yes.

Q. Does this statement also contain schedules which reflect the effect during the operating period of the alternative tax ruling which you have requested that the contributions to PRDC are not taxable income even if PRDC itself is not held to be totally exempt from income taxation? A. It does.

Q. Are you acquainted with the data on which the schedules included in this revised statement of source and application of cash have been prepared? A. I am.

Q. Is this the revised statement of source and application of cash during the period of operations to which you have referred? A. It is.

Mr. Reid: Will the Reporter mark this as Acker Exhibit No. 2.

(Acker Exhibit No. 2 was marked for identification.)

Mr. Reid: Mr. Examiner, we offer in evidence Acker Exhibit No. 2, the statement of source and application of cash during the period of operation.

The Presiding Officer: Is there objection to the

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receipt of the document which has been described as Acker Exhibit No. 2?

Mr. Sigal: I understand that Acker Exhibit No. 2 is a revision of the Exhibit 29 now in the record. Is that correct?

Mr. Sigal: Mr. Kyle, I make the same objection to this exhibit that I did to Exhibit 29.

Mr. Reid: Very well.

Mr. Morrisson?

Mr. Morrisson: I have no objection.

The Presiding Officer: The objection will be overruled and the document will be received.

(Acker Exhibit No. 2 was received in evidence.)

By Mr. Reid:

Q. Mr. Acker, would you refer to each of the individual

schedules in Acker Exhibit No. 2 and identify it briefly. A. Schedule No. 1 is a statement of source and application of cash during the ten-year operating period assuming that the company has no federal income tax liability.

Mr. Sigal: May I request, Mr. Acker, that you keep your voice up. I am sorry, I don't hear you very well.

The Witness: Schedule No. 2 is a statement of source and application of cash during the ten-year operating period

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assuming that the company has federal income tax liability and that contributions are not taxable income.

Schedule No. 3 is a statement of source and application of cash during the ten-year operating period assuming that the company has Federal income tax liability and that the contributions are taxable income.

Schedule No. 4 is a calculation of Federal income tax payments during the operating period assuming that the contributions are not taxable income.

Schedule No. 5 is a calculation of annual depreciation assuming that contributions are not taxable income.

Schedule No. 6 is a calculation of Federal income tax payments during the operating period assuming that the contributions are taxable income.

Schedule No. 7 is a calculation of annual depreciation assuming that the contributions are taxable income.

By Mr. Reid:

Q. Mr. Acker, a little fuller explanation of Schedule No. 3. Does that take into account the excess of the cost of this plant over an ordinary plant? A. Yes. One income tax deduction that is assumed for the purpose of Schedule No. 3 is that the difference between the cost of this reactor plant and the cost of a conventional plant of the same capacity would be considered by the Treasury Department as research and development expense deductible

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for Federal income tax purposes.

Mr. Reid: I see.

You may cross-examine.

Cross Examination by Mr. Sigal

Q. Mr. Acker, on page 8 of your testimony you gave a brief review of the development of the reactor project with which we are now concerned, and this review goes back to April 1951. We are interested in getting a little more detail on that history than your testimony provides. Will you tell us how this whole matter started? A. I think this is the original concept of Mr. Cisler and some of his associates. In the Detroit Edison and the Dow Chemical Company people evidencing their interest in the peaceful development of the atom and notably in the production of power from nuclear fission.

Q. For what purpose were they interested in development of a reactor? A. Looking to the future use of nuclear energy for the production of power, and that of course being based on the tremendous available resources

in nuclear energy, the nuclear materials in the surface of the earth.

Q. Did they at that time, that is, in 1951, indicate to the AEC the basic conditions under which they thought that such a reactor could be developed? I am now speaking with

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particular reference to the financing of such a project. A. I am not competent to testify as to that, Mr. Sigal.

Q. You have no— A. I was not a party to those discussions.

Q. You were not a party to them? A. I was not a party to those discussions.

Q. You mean you were not individually present? A. No. My company was not associated with this group at that time.

Q. Therefore when did your company become interested in this project, Mr. Acker? A. In 1955, according to my recollection.

Q. You have no personal knowledge of what went on prior to 1955? A. Except by discussions with the individuals involved.

Q. You have no knowledge, then, of the subject I am just raising with you? A. No personal knowledge, no, except as I obtained from discussions.

Q. What discussions did you have with the individuals involved concerning the period prior to 1955? A. When our company was interested in becoming a member of the group I had long discussions with Mr. Cisler and with some of his people and with other members of the APDA organization. They informed me as to the background of

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the formation of the organization and its purposes.

Q. Then they did not tell you anything about their original notions of how this should be financed, did they? A. No.

Q. Were you advised, for example, at any time that in December 1951 the Dow Chemical-Detroit Edison project submitted a report to AEC in which they stated that private investment in nuclear power was not feasible "without government guarantee for private capital expended and a subsidy for the materials and power produced"? A. I am not familiar with that particular statement.

Q. That statement, Mr. Acker, appears on page 11 of a report submitted by that project and is marked No. TID-10077. Do you know what contributions AEC made to the study project which Dow Chemical and Detroit Edison were interested in? A. Merely as a result of discussions, as I said before, with Mr. Cisler and representatives of APDA. I knew that the government was giving assistance but I was not personally familiar with the character of such assistance or the extent of it.

Q. Were you informed by Mr. Cisler that the AEC at that time, 1951, agreed to contribute $725,000 to the project and that Dow Chemical and Detroit Edison together would contribute $725,000? A. No, I was not familiar with that.

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Q. This also appears, Mr. Acker, in this report that I have just mentioned.

Are you familiar with the fact that in the summer of 1952 AEC made it known to the people in this project that

it did not intend to provide a guaranteed market for privately produced fissionable material and suggested that all study groups direct their attention to so-called power only reactors? A. No, I am not familiar with that, Mr. Sigal. As I have said, I was not a party to any of those discussions.

Q. You are not familiar, then, Mr. Acker, with the discussion which extended over a considerable period with respect to the relative merits of single purpose and dual purpose reactors? A. Only to the extent that I would be familiar with them by reading.

Q. You got nothing about that from Mr. Cisler or his associates? A. I can't recall that I did specifically.

Q. Were you informed of the safety problems that the study group was considering with reference to the power reactor? A. I was familiar with those at the time that my company came into the APDA organization.

Q. I call your attention to the following language on

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page 162 of this report to AEC before I quote that. This is with reference to the matter of safety and exclusion. Quote:

"Exclusion area, no matter how large, is not the answer to the atmospheric contamination problem. Instead the reactor enclosure must be designed to contain sufficient of the fission products to eliminate the hazards to surrounding territory resulting from reactor failure."

Are you familiar with that subject matter? Were you told about the problems involved? A. Yes, I have been a party to many discussions. I was at the time that our

company came into APDA and have been since, on that whole question.

Q. But you were not aware of the statements that were made at that particular period on the subject by Dow Chemical? A. Not during that period, Mr. Sigal.

Q. Are you aware, Mr. Acker, that on April 14, 1954, AEC entered into a new agreement in which AEC agreed to do $300,000 worth of the work involved in this study project? A. No, I am not personally familiar with that.

Q. Are you aware that the primary purpose of the study was, or to put it in the language of the report, quote, "emphasis has been placed on the subject of nuclear accident."

Were you aware of that? A. I am not.

Q. This report also states, Mr. Acker, at page 72 that,

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quote, "Some effort has been devoted to studies of other types of reactors." Then it goes on to say at page 75, quote, "In view of the urgency felt by private enterprise to construct a working, full size power breeder it is concluded that the best interests of the group will be served by continuing the major effort on the fast breeder."

Are you familiar with that matter, that statement or the attitude described? A. I am not familiar with the statement, as I have said before. As far as the attitude expressed is concerned, it seems to be entirely consistent. If you want my opinion and based on what has transpired since, we believe that the fast breeder reactor holds the greatest promise from the standpoint of the conservation of nuclear fuels and the ultimate economy of power production through the use of nuclear energy.

Q. Mr. Acker, perhaps you didn't get the quote clearly. Let me read it again: "In view of the urgency felt by private enterprise to construct a working full size power breeder, it is concluded that the best interests of the group will be served by continuing the major effort on the fast breeder."

The group referred to in this statement of course is private enterprise. A. I would think it referred to the group that was

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involved in the project.

Q. Then you are still of the position that private enterprise will be best served by building a full size power breeder? A. I would interpret it that way, Mr. Sigal. I would interpret it to mean that the best interests of the group as those responsible for the provision of the power requirements of their customers, would be best served by this action.

Q. You are not familiar of course with the document, as you stated? A. No, I am not.

Q. Or the discussions that went on at the time, are you? A. That is right.

• • •

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By Mr. Sigal:

Q. Mr. Acker, calling your attention to Exhibit XXI, the first page. Do you have it before you? A. Yes.

Q. Article 1, Section A, the first sentence contains this statement, quote: "APDA will furnish to PRDC without charge a complete design for those components of the

reactor plant within and including the secondary containment vessel and for the primary coolant loops which collectively are

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herein referred to as the reactor proper, as identified on exhibits A and B of this agreement."

Do you know what those components will cost APDA to produce? A. I don't think I have a statement of the cost of those particular components. I can furnish it.

Q. You have no knowledge of your own on that matter? A. I have a statement of all of the components which APDA will furnish to PRDC.

Q. A statement of all the components? A. Yes.

Q. You mean a list of them? A. Yes.

Q. Yes, but I am asking you do you know the cost of the components listed in paragraph A? A. That could be identified from the list which I have. I haven't a separate list as to these specific ones. I have those included in both A and B.

Q. Does that list give the price of each item? A. It gives the estimated cost of the item as we have included it in our cost estimate.

Q. Your answer is, then, that it does give the cost of each item. A. It doesn't give the cost, Mr. Sigal. It gives the estimate of the cost at which each item is included in the

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PRDC construction estimate. In other words, it gives the cost which we will be relieved of by reason of receiving these components from APDA.

Q. Are you drawing a distinction between the actual cost of the item and the cost that is included in the estimate? A. I am drawing a disinction between the cost to APDA, which is purchasing and erecting this equipment, and the cost at which those items are included in our cost estimate, that is, PRDC cost estimate.

Q. I see. Do you have, then, a statement showing the cost to APDA of each item and the cost to PRDC of the same item, and so on, for all the items which APDA will transfer to PRDC. A. I want to be sure that I understand your question and that I am giving you a responsive answer. I have a list which shows the items, the cost attached to each item in the PRDC construction estimate. The cost to PRDC will be nothing because they will receive this equipment in APDA without charge. The cost to APDA has only been determined of course to the extent that orders have actually been placed and bids for the equipment have been received from manufacturers.

Q. Do you have that list? A. Yes.

The Presiding Officer: Will this be an exhibit, Mr. Reid?

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Mr. Reid: Not ours, no.

Mr. Sigal: Shall we mark this Acker No. 6?

The Presiding Officer: Acker No. 6. The document will be marked Acker No. 6 for identification.

(Acker Exhibit No. 6 was marked for identification.)

The Presiding Officer: Will you furnish the Reporter a copy?

Mr. Claytor: Yes, we will.

By Mr. Sigal:

Q. Is this list which we have identified as Acker No. 6 complete for all of the equipment and devices which APDA will provide to PRDC? A. Yes, it is.

Q. You have listed in the first column the estimate material cost. What does the estimated material cost cover? A. It covers the finished cost of the particular piece of equipment referred to.

Q. That is the manufacturing cost? A. That is right.

Q. Does that include design cost? A. No, it does not.

Q. Does it include engineering cost? A. To the extent that the manufacturer did any engineering in connection with it, yes.

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Q. But to the extent that APDA did any engineering, it does not? A. No, it does not.

Q. Are you familiar with the estimate of the design and engineering costs to APDA of these items listed on Acker No. 6? A. Not specifically, no.

Q. Are you familiar generally? A. Yes, I know what APDA has spent and proposes to spend for design and development costs.

Q. But you do not know what the design and engineering costs are specifically with reference to each one of these items? A. No, I don't.

Q. The second column is headed estimated installation labor. What labor is that? A. That is the labor of erection on the site of these various items of equipment.

Q. Is APDA going to install each of these items in the reactor plant of PRDC? A. That is right.

Q. At what point does PRDC accept transfer of these items—prior to installation or when the installation is complete? A. After APDA had completed the tests.

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Q. And before installation? A. No, no. After they have completed their tests of the complete installation?

Q. Of the complete installation? A. That is right.

Q. The tests you are referreng to are the tests in the reactor itself? A. The test of this particular equipment which APDA is going to build and finance itself.

Q. You have listed a column entitled contingencies. Do you know how the figures were arrived at there? A. Those contingencies are the portion of the contingency items included in the PRDC construction cost estimate which relate to these various components.

Q. Do you know how the figures were determined? A. They represent varying percentages of the direct material and labor costs.

Q. Well you explain that statement? A. In some cases where the design is completed, where we have received manufacturers proposals or made contracts with manufacturers for the manufacture of the equipment, the contingency item might be 10 per cent.

Q. You say it might be 10 per cent. How do you— A. I can identify particular items if you are itnerested inknowing that.

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Q. Yes, take a particular item on which you say the contingency is 10 per cent, how do you arrive at the 10 per cent? A. That is based on experience in estimating

conventional steam station plants. Where we don't have the background of experience that we have in connection with conventional plants, we would use anything from 15 per cent up to 30 per cent contingency. So it is a judgment figure, Mr. Sigal. Those are judgment figures.

Q. You mean based on past experience? A. Based on past experience or current experience based on the exposure to unknown or uncertain elements.

Q. Let us take the very first item, reactor vessel. You have a contingency there of $171,600 against a total cost labor and material of $1,144,800. A. Yes.

Q. Will you tell us how you arrived at that contingency? A. On the basis of a percentage applied to that direct material and labor cost.

Q. Yes. How did you arrive at the percentage? We are now talking about a reactor vessel which has never been built before. A. That is included, Mr. Sigal, in a category listed in our construction estimate, which is an exhibit in this case, under a heading called reactor plant construction. I

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beg your pardon a moment. (Witness referring to his papers.)

That is included under a heading in our construction estimate called reactor plant equipment, and the reactor vessel is included in a group of material as to which we have assigned a contingency item of 15 per cent. The particular reason for that is that the reactor vessel itself is the largest single element in that category and we have a proposal and have placed an order with the Combustion Engineering Company for that reactor vessel at a figure which is shown.

Q. You placed an order for the reactor vessel at the price which is shown? A. No, because there are other elements aside from just the purchase of the reactor vessel itself. Of the $1,062.000, the reactor vessel, based on the proposal af Combustion Engineering, is $915,800.

Q. What is that figure? Is that the contract price? A. That is the Combustion Engineering proposal on which an order has been placed with Combustion Engineering.

Q. For the reactor vessel? A. For the reactor vessel.

Q. Why did you charge $1,062,000 for that item? A. I say there are other items included there.

Q. In this reactor vessel item? A. That is right.

Q. What other items are included?

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A. There is an allowance for extras such as loop stub piping also, thermocouples, expansion joints, for nuclear operation. We have an item to cover escalation. There is heating system material. That is heating coils for keeping the sodium fluid during the reactor shutdown. There is the erection cost. There is the rest of the reactor vessel. There is the reaction cost of the heating system.

Q. Is that all included in the million dollar item? A. There is steel shielding. The entire item which we have listed here as reactor vessel, steel shielding, internal structures, and heating system, in our estimate adds up to $1,373,900. We will receive this vessel and other portions of that equipment from APDA to the extent that it relieves that total cost of $1,373,000 by $1,316,000.

Q. What is the difference? What does that difference represent? A. The difference is in items which PRDC will itself provide.

Q. Mr. Acker, getting to the question that I asked you originally, how did you determine or how did APDA determine this contingency of $171,600 for the item of reactor vessel? Did they apply just a mathematical formula and say "This is what it will be", or was it related to some more specific information and possibility. A. It was a mathematical application of 15 per cent

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to the material and labor costs based on our judgment as to the exposure that we had for contingencies for this class of item.

Q. What experience have you had or has PRDC had with the building of reactor vessels? A. This is our first experience.

Q. So you can't rely on your experience to determine what the contingency is, can you? A. Generally speaking, that is right. Maybe, but I would like to point out again, as I said, that the major portion of the cost of this item is based on a proposal and an order which is already placed at a figure. So as to that portion of the total we see no reason that we should go any further than a 15 per cent contingency.

Q. Then your contingency is not related to the question of whether or not PRDC has determined the problems of safety with respect to the reactor vessel? A. I don't understand your question.

Q. I would like to know, Mr. Acker, whether this con-

tingency reflects to any extent any problem or doubt with respect to whether or not the reactor vessel as designed will meet the need. A. This contingency item, Mr. Sigal, is not intended to provide for changes in the design or structure of the equipment.

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Q. I see. That is true with every contingency item which is mentioned in this estimate and in the other estimates that you have submitted? A. That is true, except to the extent that the design of some of the items may not have been completed as yet and if modifications of those items is necessary then the contingency item would cover the cost of the modification.

Q. But generally speaking, certainly, so far as what you have presented here, the contingencies do not include the cost of design if changes are required? A. It might cover some of the cost of design changes but not the construction of a new piece of equipment which is to replace one which is included here.

Q. Whether or not it does include design costs, you are not certain? Is that true? A. I am not saying, Mr. Sigal, that it would include no design costs but we have other provisions for research and design changes which may be necessary in the future.

Q. So in any event with respect to these various estimates the item of contingencies is not intended to cover the design costs with reference to changes that may be required in these items? A. It may be adequate in some instances to cover the design changes. That is the point I am trying to make.

Q. Do you know of any instance where it might be

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adequate? A. In the case where we may have applied 30 per cent contingency knowing that we had only a conceptual design and didn't yet have a definitive design 30 per cent might be adequate. I am not saying there is nothing available there for design change.

Q. Can you point out any specific item where the contingency might be suffiicent for that purpose? A. I would say as to any item where we have up to, say, 30 per cent contingency it is entirely possible that a portion of that that would be available for design changes.

Q. Some portion? A. Yes.

Q. Can you say what portion? A. No, I can not.

The distinction that I am trying to draw, Mr. Sigal, is that we do not intend the contingency items to provide for any changes in the construction of pieces of equipment or to take care of modifications of pieces of equipment which have to be substituted for items included here.

Q. You mentioned in the course of your statement that the contract includes escalation. Will you explain the word escalation? A. Escalation is the provision you make for increased labor and shop material costs.

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Q. What provision have you made for escalation? A. There is a total in this classification of items which includes the reactor vessel of $91,000.

Q. Is that escalation item part of the figure that is given here as to the cost of the item? A. Yes.

Q. Is that true with respect to all other items? Do they all contain escalation provisions? A. As to I would

say the bulk of the items in our construction estimate, we have allowed for escalation, yes.

Q. Is there a flat percentage of escalation? A. I can not tell you, Mr. Sigal, the exact basis on which the escalation is determined. I can tell you who made the estimate and get the information for you if you wish to have it.

Q. Do you have with you the work sheets for the various estimates that you have provided with respect to costs and expenses? A. I do not.

Q. Do you expect to have them? A. I hadn't expected that they would be required. If they are, they can be made available, I should think.

Q. A request was made, Mr. Acker, that the work sheets that you used or PRDC used with respect to the various estimates be available. You know the various statements

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you have submitted on costs, operating expenses, and so on. We are interested in examining those work sheets whenever questions may arise. A. It is a very voluminous record, Mr. Sigal.

Q. Of course you are undoubtedly in a better position to know than we are. We are interested in being able to check those work sheets from time to time. Can they be made available tomorrow? A. I don't believe that is possible.

Mr. Claytor: Mr. Sigal, I think that the detailed work sheets to which you have made reference are available here in the form of further breakdowns and analyses of each item in the construction estimate. With respect to the construction estimate

we can make those available to you now. With respect to any other items I think we would have to see which items they are. Certainly with respect to the construction estimate we have this available if you wish it.

Mr. Sigal: Can you give me a copy? May I have it, please?

I am also requesting the work sheets for the other exhibits, Mr. Claytor, the operating expenses during construction, and income and operating expenses during operation. They may be made available.

Mr. Claytor: Yes.

I would suggest that as I hand these to you they be

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marked for identification for the future. This would be Acker Exhibit No. 7, work sheets on construction estimate, Application Exhibit No. XXVII.

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[345]

Q. Did you have anything to do with the organization

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of PRDC, Mr. Acker? A. Yes. I was one of the original members.

Q. Are you familiar with the circumstances under which it was organized? A. Oh, yes. Very early in the organization of PRDC I was appointed chairman of the

finance committee and I later on became vice president of the company.

Q. Mr. Acker, there are now 21 members of PRDC, is that correct? A. That is correct.

Q. Is there any obligation on the part of these members to continue their membership for any particular length of time? A. No.

Q. Aside from any written commitment which the members may have given to PRDC is there any additional commitment for contributions by these members to PRDC? A. No.

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By Mr. Sigal:

Q. The first sentence of Article I says that it will continue in effect for a period of ten years, but in no event beyond December 31, 1970. Your own statement indicates that you will not operate this plant beyond 1970. Do you know why AEC gave you an allotment for 23 years going up to 1980? A. Just a moment, Mr. Sigal. I don't think I have ever stated in any testimony that we would not operate this reactor plant beyond 1970. It is our intention to operate it for a ten-year period.

Q. That is 1970. A. For this purpose. But we have never stated that we would not operate it beyond that period.

Q. You have not stated that? A. No, sir.

Q. Is it your intention to operate it beyond 1970? A. I can't say today. It would depend upon the results of our operation during the ten-year period.

Q. In that case, Mr. Acker, may I call your attention

to what you said on page 24 of your testimony about the middle of the page. Your statement begins, "The period projected for the experimental operation of the reactor plant upon

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completion of the test year 1960, is ten years. We feel that at least the ten years will be required to study adequately the economic and technical aspects of the operation of the fast breeder reactor as a facility for the production of steam, usable for the generation of electricity."

Is that statement not inconsistent with what you have just said? A. I don't think so.

Q. You think that this says that you will operate for more than ten years? A. No, I don't, but my statement, Mr. Sigal, was that we had never made the statement that we would not operate beyond the ten year period.

Q. Oh, I see. All you have done is make an affirmative statement that you will operate for ten years? A. That is right.

Q. I see. A. That is geared to the period that we think necessary to prove out the economics of the plant.

Q. It is your position that none of the statements you have submitted here indicates that it is not your intention to go beyond ten years? A. That is right.

Q. That it is not your intention not to go beyond the period?

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A. There are two negatives in there. I will have to think about that.

Q. I will state it affirmatively. Is it not true that the

statements you have submitted indicate that PRDC will operate for only ten years? A. That is not true.

Q. That is not true? A. No.

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Q. On the next page, page 7, in paragraph E it says, "The Commission will and hereby does waive its use charge for special nuclear material used in connection with the project for the period commencing with the effective date of this contract and ending five years after commencement of operation of the reactor plant as established in accordance with the provisions of Article I."

If this contract is signed, say, this month, March 1957, and the plant doesn't go into operation until sometime in 1960, can you explain why the Commission would provide special nuclear materials for the period between the effective date of the contract and the date when the ractor goes into operation? A. During that period the fuel elements would be

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expected to be fabricated and special nuclear material is necessary for that purpose.

Q. In 1957? A. Not necessarily in 1957.

Q. The allocation provides for nuclear materials from the effective date of this contract. That is what it says here. Why would you need nuclear materials in 1957? A. I don't think we do. I think we are scheduled to need them in 1958.

Q. That is what the agreement provides. A. I can't see any objection to that, Mr. Sigal.

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[448]

Q. As a matter of fact, this whole project rests on the proposition that it can not operate unless AEC buys plutonium produced in this reactor? A. I think that is a fair statement. It could be operated—No, I think that is a perfectly fair statement.

[449]

Q. In any event certainly PRDC will not operate this plant if it can not sell its plutonium to the government, to AEC? A. That is true.

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Q. As a matter of fact, I assume you know, Mr. Acker, that no fast breeder reactor has been built which has survived all tests made? A. I think that is a fact.

Q. So there is now no experience in any organization, be it AEC or PRDC, with respect to the building of a successful fast breeder reactor which is safe.

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A. I would not make that statement, Mr. Sigal.

Q. Because you have no knowledge of it yourself? A. That is right.

Q. You say that the risk to PRDC is roughly the cost

of building the reactor, namely, about $40 million. Well, what— A. I would say it is contributions to which the member companies are committed plus the amount of the loan which they will have guaranteed.

Q. That is about $38 million? A. About $38 million.

Q. What provision has PRDC made to meet that risk? A. That financial risk?

Q. Yes. A. I don't know that it has made any provision. If it had made provision, Mr. Sigal, it would not be a risk.

Q. When you say that there is a risk in proceeding now are you asserting that if the schedule can not be met, PRDC will abandon the project rather than put any more money into it in order to build it at a later date? A. No, I am not saying that at all.

Q. All right, then, I am asking you what arrangement has PRDC made to meet the risk that its original plans may not work out? A. It has made no arrangement. Whatever arrangements

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were made would depend on the circumstances at the time that it was faced with that decision.

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[494]

By Mr. Sigal:

Q. Mr. Acker, will you look at page 5 of this exhibit, this summary? A. I have it, Mr. Sigal.

Q. That shows at the end of the total estimated plant cost; is that right? A. That is right.

Q. $32,400,000? A. That is right.

Q. That does not include, does it, certain other engineering and research matters that are necessary during construction?

For example, that item does not include the $5 million that PRDC says it will spend during construction, does it? A. That is right.

Q. Can you tell us what is the actual cost of construction, including all items spent during the period that you call the construction period? A. That would be shown on page 7. Do you have a page 7 to your exhibit?

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Q. Yes. A. $43,216,000.

Q. Is that cash outlay by PRDC? A. No, that includes $7 million received in test equipment and devices and research and development expense by APDA.

Q. So according to that figure, the amount of money actually expended by PRDC would be $36,216,000; is that right? A. That is right.

Q. If that is the amount actually expended during that period, what amount will PRDC have in its reserves at the time that construction is completed? A. As I remember it, Mr. Sigal, PRDC will have a balance at the end of the construction period of $3,499,000.

Q. How do you derive that figure? A. I think that is stated in my testimony, Mr. Sigal.

The Presiding Officer: Page 13 of your testimony?

By Mr. Sigal:

Q. You stated that in the first paragraph on page 13.

Can you tell us how you derived this figure? A. Yes, anticipated total resources of PRDC, including the $7 million from APDA, is $45,540,000. The reactor cost, overall, including the $7 million value placed on the contributions of APDA, is $43,216,000, and the difference, I think, is $2,324,000.

If you add to that the provision for working capital

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which we expect to have at the end of the construction period in hand, you get a total of $3,499,000.

Q. If you are going to include that $1,175,000 as a statement of your excess over costs, then certainly you ought not to include that same $1,175,000 in the statement of your construction expense, should you, Mr. Acker? A. It depends on how you want to show it, Mr. Sigal. That is a provision which must be made and must be available during a construction period involving expenditures of this size to provide for meeting payroll, meeting all kinds of expenses from time to time.

It, in effect, Mr. Sigal, is the amount that you hope to maintain and expect to maintain and should maintain in your bank account to meet whatever disbursements are necessary. It is not considered as an expendable item, in other words. It is a provision for evening out your expenditures over a period.

Q. It is not a fund or a sum that you spend? A. That is right.

Q. So to call it a cost of construction, as you do on page 5, is stretching it a little, isn't it, Mr. Acker? A. I don't think so. I think it is an item that any body faced with the construction of any plant must take into con-

sideration. The money must be provided whether it is expended or left over at the end of the period. It has to be in hand and has to be in the bank available for use.

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Q. In any event, your statement is that this is not a sum that you intend to expend? A. That is right.

Q. During the construction period? A. That is right. You will see by the same token, Mr. Sigal, that it is continued all through the operating period, as well.

Q. Yes.

Does this construction estimate, this exhibit, indicate all the expenses that you anticipate having during the construction period? A. It does.

Q. This does not cover any expenses that go beyond the construction period, does it? A. Let me check that.

Yes, this includes an item of $550,000 for initial operation from low to full load which covers the cost of the test year which immediately follows the completion of construction.

Q. Why did you include that item in the construction estimate if this is not attributable to construction? A. It is a question of judgment as to where to put that kind of item, Mr. Sigal. Is the test year part of the construction period or is it a part of the operating period? That is just a question of semantics, it seems to me.

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Q. In your opinion, at least as this exhibit reflects, the test year is part of the construction period? A. To the extent that we have included the cost of conducting the

test during the test year in the construction estimate. It might be put that way. It really doesn't make any difference, Mr. Sigal. You have to make the provision either way; however you want to characterize it.

Q. This is for the purpose of analyzing your statement, Mr. Acker. All I am asking is, is it not true that PRDC judged this to be a construction cost inasmuch as it included the item in its construction estimate? A. I suppose that inference could be drawn. It seems to me it is academic.

Q. Is it a fair statement to say that in your testimony whenever you refer to construction and its cost, you refer to the matters which are included in this construction estimate? A. That is right.

Q. Will you examine Item L, that is, the detail on the preoperation testing after construction? A. Yes.

Q. The introduction to this statement—by the way, I am quoting from Item L in Acker Exhibit No. 7 for identification—quite:

"This capital item is an expense that occurs before the plant is ready for commercial operation. It includes

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only operating expenses and does not include any of the costs of money or taxes other than social security taxes.

"The expense is incurred after completion of the plant construction and before it becomes critical. It includes final adjustments to all plant equipment, minor changes and an item for inspection and testing of the initial loading of core and blanket elements. In addition, the expense covers several weeks that

are required for the progressive loading of the reactor core, carefully measuring the approach to criticality after the addition of one-third of the core elements and again after each additional element is added to the core. The hold-down plate is lowered, the reactor locked, and control rods lowered after each element addition."

The cost of that item is $350,000, estimated. A. Right.

Q. The description there indicates what has to be done up to the point of reaching criticality, doesn't it? A. That is right, up to the point of beginning of operation of the plant.

Q. The actual operation? A. That is right.

Q. Of course, it includes, as it says, the insertion of nuclear fuel into the reactor? A. Yes. Obviously that can't be done until we get an

[500]

operating permit.

Q. Is that so? A. That is right.

Q. Where does it say that, Mr. Acker? A. It doesn't say that.

Q. You know that of your own knowledge? A. I believe that to be the fact.

Q. Is there anything in the record which so indicates? A. Not that I know of.

Q. Will you turn over to Item N, which is titled, "Initial Operation, Low to Full Load"?

"This allowance provides for the cost of one year's operation that is required to bring the reactor to a condition of safe operation at full load. After the reactor becomes critical it is loaded to give a small

heat output and the control and safety rods operated to determine their effectiveness. These tests are repeated many times in the process of calibrating control roads and proving that the safety rod characteristics are satisfactory.

"After these tests which require several months, other tests estimated to take about six months will be performed. These tests required to prove reactor stability include a long series of tests with oscillating reactivity applied to the reactor core with programmed reactor

[501]

loadings and oscillator frequencies."

A. Right.

Q. Are you prepared to explain that second paragraph?

A. No.

(Laughter.)

You knew the answer in advance, Mr. Sigal.

Q. In any event, Mr. Acker, it is clear from this statement that this refers to a process which is involved in the operation of the reactor after it reaches criticality? A. That is true, Mr. Sigal.

Q. I assume you are aware of the fact that perhaps the most dangerous period in the life of a reactor is the moment of bringing it to criticality? A. I cannot state that as a nuclear expert, Mr. Sigal, but just as a layman I would assume that that would be a proper statement.

This operation obviously is another that could not be undertaken until we have an operating license.

Q. Under this statement, Mr. Acker, it appears that the

preoperation testing in the initial operation to full load will begin somewhere around 1959 or 1958? A. It is scheduled for the end of 1959. The preoperational testing would be at the end of 1959. The initial operation low to full load is scheduled for 1960.

Q. The entire year? You mean it will begin in 1960?

[502]

A. That is right. Our program and all of our operating schedules have set aside the full year 1960 for that operation.

Q. Will you look at Figure No. 1 which was referred to before in Mr. Amorosi's testimony?

You will note there on the right-hand side of that figure, under 1960, that the preoperation testing is to begin in December of 1959. The criticality date is set at December 15, 1959, according to this picture; is that right? A. According to this statement, that is true. I think there is a difference in terminology.

Q. Mr. Acker, I don't know whether the PRDC representatives differ in their use of these words, but this figure uses the precise language that you have used in the construction estimate. A. That is true, Mr. Sigal.

Q. This whole year of 1960 is shown as devoted to preoperation testing. If a year is devoted to that, then it would appear that another year, 1961, will be required for the second operation, namely, the initial operation low to full load, according to your own statement. A. Mr. Sigal, that is not the intent. There is a confusion of terms here, and I will readily admit it. The preoperation testing as included in Mr. Amorosi's exhibit is the item which we dis-

cussed before in our construction estimate designated N, Initial Operating, Low to Full Load.

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[505]

Q. * * * I think I asked you earlier about a possible breakdown of the $5 million estimate on research and development by PRDC, and your statement was that that wasn't available. A. That is right, there is no specific schedule of proposed research and development expense. That is an allowance for whatever we may do or be required to do.

Q. There is an item of $4 million by APDA for similar work. Is there any breakdown of that? A. That is included in the APDA budget for the years 1957, 1958 and 1959, which is in evidence in this proceeding.

Q. You have no other breakdown than what appears on that exhibit? A. I have none.

Q. You are aware, are you not, Mr. Acker, that the experts and consultants for PRDC anticipate that there may

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be substantial changes in components during the course of construction and prior to the time they actually get into operation? Are you aware of that? A. During the course of construction?

Q. Yes. By "construction" I am taking it up to the point of actual operation. A. There may be changes required as a result of the test of the APDA equipment and devices which they propose to furnish to us.

Q. Or as a result of the research work done by APDA

or PDRC there may be changes required? A. That is conceivable; yes.

Q. Or work done by AEC? A. That is conceivable.

Q. Or any consultant that you may use for this purpose? A. Yes. The reason that I qualified what I said previously was that all that work that you refer to will be in the course of completion during this three-year construction period successively. If the result of some of the tests that are to be made show that changes are required in any of the proposed components of the reactor plant before they are actually fabricated, then, of course, we will not be subjected to additional cost for new items.

Q. What happens if you learn about these things after the designs are frozen?

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A. Then we are exposed to additional costs for new design. If the piece has been fabricated, we are certainly exposed to the cost of replacement.

Q. What provision have you made to meet that contingency? A. We have $5 million, as I told you, which is unassigned for the most part.

In addition, in our estimate we show as the estimated cost to us of the equipment and devices which APDA will furnish us about $4,100,000. In our financial statement we have estimated the value of those pieces of equipment and devices at $3 million.

That is in on both sides of the equation. We have considered that as a cost in our financial schedules and we have considered it as a receipt. We could have put it in dollars on either side. The difference between that $3 million which we have in our financial schedules and the

$4,100,000 which is included for the same items in our construction estimate, perhaps $1,100,000, would be available for such changes and adjustments as have to be made.

Q. So your estimate, then, is that you will have $1 million available for that purpose? A. We will have $1 million, plus whatever portion of the $5 million which would be available for the purpose, as well.

Q. Let us assume, Mr. Acker, that the amount required to make the changes exceeds $5 million or $6 million. What

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will PRDC do to meet that contingency? A. Mr. Sigal, you are asking me personally. I am not the least bit concerned about that. These companies will have put in $25 million, and will have put into APDA reserve previously $6,700,000, something on that order. With that kind of investment in a very important project, I see no possibility —if you want to qualify it, I will say no reasonable possibility—that these companies would not come forward and put up the additional money required to complete the job which they had undertaken.

Q. The fact is, Mr. Acker, that PRDC does not have the resources now, it doesn't have any commitments to take care of any of the contingencies you are now mentioning, does it? A. Yes.

Q. What is the provision? A. It has the $1,100,000 that I spoke of, plus whatever portion of the $5 million that could be used for that purpose.

Q. My question to you was, suppose the additional costs exceeded $6 million? Where is PRDC going to get the money? A. I thought I indicated that very clearly, Mr.

Sigal, that it would come in my opinion from the member companies who, I think, would be glad to put up the additional money required.

Q. My question to you, Mr. Acker, is, is it not true that at the present time there is no commitment from anybody,

[509]

any member of PRDC, to give one cent more than they have now committed themselves to give in these letters of commitment? A. That is perfectly true, but I would like to say that it would be most difficult to get anybody to make a commitment for an unknown amount.

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[513]

By Mr. Sigal:

Q. Do you know what force that containment vessel is planned to contain? A. I am not qualified in that field, Mr. Sigal.

Q. If it should turn out, Mr. Acker, that the estimate is wrong, is it not quite possible that the entire vessel will have to be rebuilt? Obviously, if it is too weak to contain the force for which it is intended— A. If the calculations upon which the strength of the vessel was based are wrong, it might have to be rebuilt or it might have to be reinforced or an additional might have to be placed outside. Anything might happen.

Q. Are you aware that there is a serious question in this case as to what nuclear accident might have to be contained or the force of such an accident? A. Yes, I am aware of that.

Q. Hasn't PRDC gone ahead and made its plans with respect to the kind of vessel it will order without waiting for final experimental results on this question?

[514]

A. That is true. Those experimental results would be expected to confirm the theoretical calculations of the engineers and scientists who have made the assumptions on which the design was based.

The Presiding Officer: Mr. Acker, did you finish your statement?

The Witness: Yes, I did.

By Mr. Sigal:

Q. That vessel would have to be ordered and built prior to the time that those experimental results are available, won't it, Mr. Acker? A. That is right. That is one of the financial risks that we are assuming.

Q. Are you prepared to say that the members of PRDC will go so far as to pay for the complete rebuilding and redesign of the reactor in the event the experiments show serious fault in the whole structure? A. You mean just the reactor itself, or the reactor plant.

Q. I mean the whole project. Are they prepared to start from scratch to redesign and rebuild the reactor? A. No, I am not prepared to say that, Mr. Sigal.

Q. Let me call your attention, then, Mr. Acker, to this statement which appears in the testimony of Mr. Bethe, page 56.

[515]

A. I have it, Mr. Sigal.

Q. I call your attention to the last full paragraph on page 56. I will read it.

> "To measure in particular the prompt positive temperature coefficient, we shall reduce the flow of coolant to a very small amount, possibly shutting it off completely, and we shall use very low power, perhaps one percent of normal operating power. If then the power oscillation is in phase with the reactivity oscillation, this indicates a positive prompt temperature coefficient; if it has the opposite phase, then the temperature coefficient is negative. If in this experiment, contrary to what I believe will be the fact, the temperature coefficient should turn out to be positive, we shall take the reactor apart and redesign it."

Did Mr. Bethe make that statement with the authority of PRDC officials? A. I have no knowledge of on what basis he made that statement.

Q. You are not prepared to state that PRDC will take the reactor apart and redesign it if it turns out that it is so seriously defective as indicated? A. I am not prepared to state that. That would be a management decision, Mr. Sigal, obviously, which could be made only at the time and under the circumstances.

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[636]

Q. Since we are on that exhibit, I would like to ask just a few more questions.

Mr. Acker, I would appreciate it if you would make one more mathematical calculation. Have you brought your

slide rule this morning? A. No, I did not, sir. It is in Poughkeepsie.

Q. We calculated the figures derived from dividing the estimated income of PRDC for plutonium sales by 106 for each year; is that right? A. That is right.

Q. We, I think, did not finish those calculations.

The figure 106 per year is taken from Intervenor's Exhibit No. 1, which shows that PRDC estimated the production would be 106 kilograms of plutonium per year; is that right? A. Yes.

Q. Now, assume that that figure 106 is an average annual production for 10 years; that would mean the total production

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for the 10 years would be 1060 kilograms; is that right? A. On that assumption, yes.

Q. On that assumption, yes.

Will you please divide the figure 48,623,000 by 1060? A. That is approximately $46.

Q. Per gram? A. Per gram.

Q. Mr. Acker, I think you heard Mr. Morrisson, counsel for AEC, state yesterday that the price per gram of plutonium which the AEC will pay to licensees who produce it beginning July 1, 1962, will be $12.

Mr. Claytor: I object, your Honor. That is an incorrect statement, I believe.

Mr. Sigal: I thought that is what was said. If that is not correct, let me read to you, Mr. Acker, the release issued by AEC on this subject dated November 18, 1956.

The Witness: Yes.

By Mr. Sigal:

Q. "The Atomic Energy Commission has established guaranteed fair prices to be paid for plutonium and Uranium 233 produced in atomic reactors operated under license in the United States and delivered to the Commission for the one-year period beginning July 1, 1962.

"The prices are, for plutonium metal, $12 per gram. For Uranium 233 nitrate, $15 per gram of U-233.

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"These prices are based on the estimated fuel value of the materials and are identical with those to be paid for these products of reactors abroad fueled with material supplied by the United States."

A. Yes.

Mr. Sigal: I would like to call Mr. Claytor's attention to the language Mr. Morrisson used yesterday if he still has any question about it, on page 600 of the transcript:

"There is a further unclassified price of $12 a gram which has been guaranteed from June 30, 1962 to June 30, 1963."

Mr. Claytor: That is right. I think you said after 1962. I got the impression that applies to the rest of the period.

Mr. Sigal: I had no such intention.

Mr. Claytor: Very well. It is correct now, anyway.

Mr. Morrisson: I think we should clarify the

record in one other respect, Mr. Examiner. Mr. Sigal's statement was that I said that the $12 price was the price which the Commission would pay. That is not what I said. I said that is a price which has been guaranteed.

The Presiding Officer: I noticed that; yes.

Mr. Sigal: I greatly appreciate the correction. I think that is very illuminating. I think the appropriate

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argument will come at a later date as to what the significance of the difference is.

By Mr. Sigal:

Q. PRDC presumably was aware of this release at the time it was made, would you not say, Mr. Acker? That is, November 18, 1956? A. Yes. We have a copy of it.

Q. You have a copy of it? A. Yes.

Q. You stated earlier that the Exhibit XXIX which gives the estimates of income for the operating period was prepared in the latter part of December, 1956; is that right? It is dated December 31, 1956. A. That is right. But in all fairness, Mr. Sigal, we have been making studies on which these figures are based for some period before that time, a matter of months. So that some of the figures reflect considerations which were determined a long time prior to December 1956.

Q. You mean that the considerations that you had in mind in December 1956 did not include the announced price, or this announcement of AEC in November 1956? A. They took that into consideration; yes.

Q. In so far as any calculations for the year beginning July 1, 1962 are concerned, they presumably took into consideration this announcement of AEC, did they not?

[640]

A. They certainly did.

Q. And furthermore, with respect to any calculations for the years thereafter, they took into consideration this announcement of the AEC? A. They took into consideration, Mr. Sigal, everything that we knew at that time.

Q. Everything that you knew in December of 1956? A. That is right.

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[690]

Q. And at the present time you have no commitments of any kind from your member companies or banks for the contribution or loans in excess of the amounts which have previously been testified to, is that right? A. That is right.

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Cross Examination by Mr. Maslowski

[707]

Q. There has been a considerable amount of discussion in so far as the loan guarantee is concerned, and in so far as this assistance is concerned that the members of APDA may be giving PRDC. Were there any special reasons for this kind of a setup? A. Do you mean with the two different organizations?

Q. Yes. A. Yes. The APDA group was a group interested primarily

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in research and development, and the creation of a conceptual design and study of the whole problem of the application of nuclear fission to the production of electricity, or heat that could be used for the production of electricity. The PRDC group represents such members of APDA, with several others added, who were interested in carrying the research and development work on from that point, and actually putting up their money to construct a demonstration reactor plant. It just represents a difference in the particular interests of the members of each group, bearing in mind that there are a number of companies that are common to both.

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Cross Examination by Mr. Morrisson

[729]

Q. As I understand your testimony of the other day, Mr. Acker, you indicated that the contingencies in general are not intended to cover design changes. Is this correct? A. That is my understanding.

Q. What provision, then, have you made to cover the cost of possible alterations in the designs of the reactor plant? A. To cover the alterations, the cost of the redesign, or of the equipment that might have to be substituted for something already purchased?

Q. Let's cover it both ways. First of all, the possibility

that design changes may be be made prior to the time the equipment is ordered, which increases its cost; secondly, the possibility that design changes may be made after equipment has been obtained so that it is necessary to scrap that equipment and substitute something else. A. We have discussed before in this proceeding the

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$5 million allowance that we have in the PRDC over-all cost estimate for research and development work. I would think that design changes would be covered by that item. You will remember that there is an aggregate of $142,000 of contracts allocated to that item to date. In addition, the amount at which we have the test equipment and devices to be received from APDA, included in our cost estimate the approximately $4.1 million, whereas, in our financial figures, we have taken that in at only $3 million. So the difference would be available in our resources to take care of equipment changes. I would think that the $5 million would be available for design, and approximately $1 million would be available for changes in equipment. If either or both items were not sufficient to take care of modification of plant equipment, we would expect that our member companies would be glad to put up whatever additional amount were required. There are, however, no commitments on their part to do so.

Q. I want to come back to that in a moment. Let me ask you this: Is the $5 million intended as a provision for increased procurement costs that might result from design changes, or increase in construction cost? A. No, it is not. It could be, if there were any available, but

that is not the intent of the item in the construction estimate. It is for research and development, re-design, anything of that kind.

[731]

Q. And there are a number of, at least, possibilities in which additional research and development might be found necessary? A. That is right.

Q. Let me inquire a little more about this $1 million item which, as I understand, is the difference between the $4.1 million, in which there is included in the construction estimate the cost of those components which APDA will procure, and the $3 million which is charged as APDA's contribution to the project. Is that a correct explanation? A. Right.

Q. Exhibit XXI to the license application, or suppose I call it license Exhibit XXI—

The Presiding Officer: To distinguish it from Acker?

Mr. Morrisson: Yes.

By Mr. Morrisson:

Q. That is the agreement between PRDC and APDA? A. That is right.

Q. Article 1-B of that agreement states, does it not, that the equipment and devices referred to in that article will be transferred on a where-is, as-is basis, and APDA will be compensated therefor on the basis of the salvage value of such equipment and devices as determined by agreement. Is not this $1.1 million, then, an amount which PRDC

[732]

is obligated to pay to APDA in compensation for the equipment and devices which APDA will transfer? A. No. In connection with the salvage value, discussions between APDA and PRDC fix the basis on which the salvage value will be calculated, and it has been agreed that it would be the scrap value of the metal involved in the APDA test facilities and devices. Based on calculations as to the quantities of various classes of metal involved and the scrap values of such metals, the salvage value, for purpose of calculation at this time, is indicated at about $55,000.

Q. Where does that appear in the cost of construction that PRDC would pay? A. I don't think it appears, Mr. Morrisson.

Q. This is not a final agreement as to the salvage value, but it is the present basis of the discussion? A. That is our estimate of what it would be at this time, that is right.

Q. Then is not the actual contribution made by APDA to this project, that is, in addition to the $4 million which it is to put up for research and development, is not its actual contribution the difference between $4.1 million, which it will pay for these components, and the $55,000 which it will receive for them? A. I would say that was a fair statement.

Q. This is the amount that APDA will be out-of-pocket in connection with its participation in the construction

[733]

of this component test facility? A. Yes. If its costs are in accordance with our estimates and our own cost estimate.

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[761]

Q. Has the management of PRDC considered the magnitude and cost of these possible changes and made any determinations as to whether the financial arrangements which they have made will be adequate to take care of this sort of change? A. I am really glad to have the opportunity to clarify our position on that matter, Mr. Morrisson. I believe I testified previously in answer to Mr. Sigal's question somewhat along the same line to the effect that when we were

[762]

faced with whatever recommendations we might have from Dr. Bethe in particular it would be a management decision at the time depending on the circumstances. I was thinking as the chairman of the finance committee of PRDC at that time principally in the financial concept. So far as the safety features of this reactor are concerned, it is the full intent of the management of PRDC to accept and abide by the recommendations of its consultants, its nuclear experts in this field and in particular and specifically, if you will, Dr. Bethe. I can not conceive that the management of PREC would go forward with this project if there were any question by their own consultants as to the safety of the reactor, and of course it is obvious that the reactor can not be operated without a license from the AEC, and it is my understanding that they, too, have to be satisfied as to the safety of the reactor.

As against the possibility of changes having to be made in connection with the recommendations of our consultants, I will say that we do not have the complete financial situation that we might be faced with covered by firm commit-

ments at this time, but I express my own opinion, as a result of discussions with my associates in this project, that having gone forward to the extent that we have in financing this project and with the interest that we have in its completion, I have every confidence that these companies will put up the additional funds necessary to take care of whatever adjustments,

[763]

changes, modifications are required.

Q. You say this is your opinion based on discussions with your associates. Has this matter specifically been discussed with the member companies? A. We have had many discussions, Mr. Morrisson, as to the future possibilities in connection with modifications and changes of this reactor plant.

* * *

[778]

Q. This comes to a question I was going to take up with you anynow. On the table that shows the calculation of steam revenue you have shown an increase in net plant capability starting from about 103,000 kilowatts in 1961 and increasing to 155,000 in 1966, and subsequent years? A. Right.

Q. This corresponds, I take it, to a similar increase in the table entitled "Calculation of Plutonium Reserves," it says here, but I think that should be "Revenue", should it not? A. Where is that reference?

Q. There is a small sheet as part of Acker Exhibit No. 10 entitled "Calculation of Plutonium Reserves." I believe the word should be "Revenue" rather than "Re-

serves." These pages are not numbered so I can't identify it more directly than that.

That shows an increase in reactor power level expressed in megawatts of heat running from 300 in 1960 up to 430 by 1966, and subsequent years.

[779]

A. That is true, Mr. Morrisson. I would like to call attention to the fact that quantities of plutonium produced are omitted from this exhibit in as much as they would lead to possible calculations from which the price schedule for the plutonium could be derived. Again the assumption on which we have based our plutonium revenues is that the current classified schedule will continue in effect throughout the operating period.

Q. I was asking you at the moment only about the reactor power level and the change in that power level which is shown on these two exhibits. A. I would like just to clarify what I said a little further, and that is that my understanding is that the present price schedule for plutonium provides for different prices for different qualities of plutonium. The price announced for the period beginning June 1, I think it is, or July 1, 1962 through July 1, 1963, is published as a base price, and our plutonium revenue figures are based on the assumption that there would be different prices available during that year and thereafter for different qualities of plutonium.

The Presiding Officer: Should that exhibit be corrected so the word "reserve" is changed to "revenue"?

Mr. Claytor: I think we should note on the record that the heading of the sheet entitled "Calcula-

779

tion of Plutonium Reserve" in Acker Exhibit No. 10 for identification

[780]

should read "Calculation of Plutonium Revenue", not "Calculation of Plutonium Reserve."

The Presiding Officer: Very well, the amendment may be made.

Mr. Morrisson: Thank you.

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[781]

Q. Does this manning table cover the personnel requirements for the entire plant which will be operated by PRDC? Let me clarify my question. In APDA 115 which is in

[782]

the record as an exhibit to the license application—

Mr. Claytor: Exhibit X-A to the License application.

Mr. Morrisson: On page 106 there is a plot plan of the plant which shows various structures, the reactor building itself, the steam generator house, the central house for electrical equipment, the sodium and gas building, the service building, a building for decay storage, a sewage plant, holdup tanks for waste disposal, railroad tracks and various other things of that kind. This manning table represents, does it, the personnel force required to maintain and operate all of these buildings and the associated grounds?

A. That is true.

Q. If you will come back to the figures on steam and plutonium revenue, on the steam revenue figure you have projected here an availability factor which starts at 40 per cent and rises ultimately to 80 per cent. A. That is right.

Q. How does this compare with a plant availability factor on a new conventional generating plant? A. It would depend greatly, of course, on the use to which the plant was put, whether it was a base load plant or was being used as a peak load carrier.

Q. Let us assume a base load plant. A. On the average I would say that the availability

[783]

factor might be considerably higher for a conventional steam plant than the ultimate figure of 80 per cent which we have projected.

Q. Higher than the ultimate figure of 80 per cent? A. That is right.

Q. In the initial years what sort of availability figure would you assume on a conventional plant? A. It would be very much higher if you could fit it in to the base load of the company.

Q. Assuming you could use the power? A. Yes.

Q. In your situation here Detroit Edison is obligated, is it not, to buy whatever steam the plant produces whether or not Detroit Edison can use that steam? A. That is right.

Q. So there is no problem of fitting it into a load, the plant will sell whatever steam it can produce? A. That is right.

Q. This factor is therefore a factor which reflects your

judgment as to what is now a reasonable estimate of what the plant can produce? A. That is right, and one factor of the rate paid by Detroit Edison takes into account the availability of the plant.

Q. This is quite an uncertain item, is it not, at the

[784]

present stage of development of the plant? A. Yes, it is.

Q. In other words, the actual availability could be substantially higher than you have shown here? A. It could be higher or lower.

Q. Or it could be lower? A. That is correct.

Q. I note that the steam agreement, which is one of the exhibits to the license application here, Exhibit XXV on page 11, in paragraph numbered D, states that "In view of the experimental nature of the project of the company extended shutdowns of reactor plant may be required in addition to regularly scheduled shutdowns for nuclear material loading and for maintenance."

Have you taken that possibility into account in projecting this availability factor of the plant? A. We have to the extent that they can be taken into account with the knowledge that we presently have before us, Mr. Morrisson.

Q. Is it your assumption that these shutdowns are more likely to occur in the early period than in the later period of operation? A. I would think so, or during the middle period of operation.

Q. This is perhaps a detail, but just as a matter of

[785]

interest why is it that the availability factor is shown at a lower figure in 1967 than in 1966? A. That is because of

allowance being made for scheduled shutdown for a part of that year.

Q. A scheduled shutdown for what purpose? A. For general overhaul and maintenance.

Q. I see. Is that the only such general scheduled shutdown that you have allowed for or are there others? A. I can not say in detail, Mr. Morrisson, but I would say that there is provision in these assumptions of availability factor for incidental shutdowns from time to time. This is a scheduled proposed shutdown.

Q. Now if you will turn to the table entitled "Calculation of Plutonium Revenue" you have testified, have you not, that these revenues are based on the assumption that certain prices which have been guaranteed for a limited period of years will continue applicable throughout the operating period of this reactor? A. That is right, Mr. Morrisson.

Q. This is only an assumption, is it not? A. That is a pure assumption.

Q. So the actual revenue figures could differ substantially from those shown on this chart, depending on whether that assumption turns out to be valid? A. That is true.

[786]

Q. These figures are also based on certain assumptions as to plutonium production, and you have explained that the detail figures on plutonium production can not be given here. A. That is right.

Q. My question, however, is, given the present state of knowledge about the reactor, do you believe it is possible to estimate now with a high degree of reliability what the quantities of plutonium production will be, or is this also

a factor which is subject to a considerable range of uncertainty? A. No, Mr. Morrisson, I am advised by our staff and consultants that on the basis of specific assumptions as to power levels, and so forth, the production of plutonium can be accurately estimated.

Q. But this does depend upon specific assumptions as to power? A. That is right.

Q. This reactor has not yet been built. Can you say with assurance that it will achieve 100 electrical kilowatts of power equivalent or that it will not achieve more than 150? A. No, I don't think that I can say that specifically for myself. Any statements made, any assumptions made, are based on theoretical calculations of our staff and consultants.

[787]

Q. In other words, these assumptions are based on the best information available to you at the present time? A. That is right.

Q. But any projection as to the physical fact with respect to the operation of this reactor in terms of the power it will achieve, the quantities of plutonium it will produce, the quantities of steam it will produce, are all merely estimates at this point based on the projected operation of a plant which has not yet been built? A. Yes.

Q. Besides which there is not much operating experience of this character? A. I believe you could say, Mr. Morrisson, if the assumptions are sound, the results can be accurately calculated.

Q. Yes, I understand that. The same observation may be true with respect to the quantities of material

which will have to be submitted for chemical processing and therefore the cost of chemical processing, is it not? A. Yes, that is very true.

Q. Can you tell me whether the data on which this table was based assume a reloading cycle under which the plant will be shut down for reloading once a week or whether they assume a change in that reloading cycle? A. I am not competent to testify as to the projected

[788]

reloading cycle, Mr. Morrisson.

Q. Who would be competent on that? A. Mr. Amorosi.

Q. Then if I can summarize a little bit the picture on the operating side we have identified a number of kinds of uncertainties with respect to the operating costs and revenues of the plant, and when I use the word "uncertainty", Mr. Acker, I don't use it in any critical sense. I am simply trying to point out that in the state of our knowledge, with this being frankly an experimental plant it simply is not humanly possible to project these costs and revenues with the degree of assurance that one might have with a conventional plant. Isn't that so? A. That is certainly true. The very reason for the construction and proposed operation of this plant; Mr. Morrisson, is to remove these uncertainties.

Q. Your purpose in building the plant is to find out what these figures will be? A. Exactly.

Q. That is right. We have identified a number of factors of this kind as to which, while you have estimates which you believe to be as valid as you can make them, there are elements of uncertainty. Perhaps we could classify those into two types. One type concerns the physical

facts of operation of the plant, what power loads will be achieved, what burnup

[789]

it will achieve, what quantities of plutonium it will produce, what quantities of material will have to be processed chemically, and the like. This is one area where there are some uncertainties. A. That is very true.

Q. Another area to which we have referred concerns the prices which you will be charged or will pay for certain of these things, including the price for plutonium which is guaranteed for a limited period, including also, I believe—and correct me if I am wrong—the cost for chemical processing as to which you have a proposal covering the period up to 1967, I believe. A. That is right.

Q. And incidentally, that proposal itself indicates that there may be some adjustments, does it not? A. That is right.

Q. Finally, there are use charges which are computed on the basis of a Commission price for uranium which also is not a guaranteed price throughout the period of operation? A. That is true.

Q. Perhaps when I was talking about the physical facts I might have mentioned also the manpower requirements, some of which also will have to be firmed up following the submission of more detailed information on some of the operating procedures of the plant.

[790]

A. That is right.

Q. So there are these kinds of areas as to which precise prediction is difficult at the present time? A. That is very true.

Q. What you have attempted to do, as I understand this, is to give your best estimate based on present information, recognizing that the actual outcome might be very different, that it might be more favorable or less favorable? A. That is perfectly true. We are up against the same thing that we would be up against at the start or beginning of any commercial enterprise. The areas of uncertainty here are greater, however.

* * *

Q. Has there been discussion by the management of PRDC or with the member companies as to what your situation would be during the operating period should you fail to receive the revenue which you have projected on the schedules or should your costs exceed those which have been projected on these schedules? A. There has been no specific discussion to that effect.

Q. Has there been recognition of the possibility that

[791]

conditions could be such that the operation of the plant would result in a net cash deficit? A. Oh, yes.

Mr. Sigal: Mr. Examiner, I think there is a limit to the extent to which this kind of question should go. Mr. Acker said in response to the previous question there had been no discussions. That seems to me to settle that question. Now Mr. Morrisson goes on and asks for recognition. What does that mean? The look in somebody's eye? There have been a lot of questions like this by Mr. Morrisson indicating the kind of answers that are desired, and it is no satisfactory explanation to say that this is cross examination.

Mr. Morrisson: Mr. Examiner, I have asked my question and it has been answered. I don't think there is a question outstanding unanswered.

The Presiding Officer: Very well. You may proceed, Mr. Morrisson:

By Mr. Morrisson:

Q. Have you computed, Mr. Acker, the values of the inventory of source and special nuclear material which will be in the possession of PRDC or under its custody and control during the operating period? A. Yes, those figures are available.

Q. I don't think they appear on any of these exhibits, although I think they can be determined by computation from

[792]

the figures which you have given for either the use charge or the value of its waiver? A. I think you are right, Mr. Morrisson. I think they appear for the years during which the use charge would be applicable assuming that the waiver of the use charge would be made.

Q. I think you gave a quantity in kilograms but not a value. Let me get it at this way: It is my understanding that the value of the inventory during most of the operating period from 1961 on would range somewhere between 16 and 18 million dollars. A. I believe that is correct.

Q. Is that substantially correct? A. Yes.

Q. What provision have you made or do you anticipate making to reimburse the Atomic Energy Commission in the event that this inventory or part of it were destroyed or rendered unusable? A. I can't say that any

specific provision has been made, but I would like to call attention to the fact that some of the member companies of PRDC have guaranteed the bank loan of $15 million. If there were financial obligations of PRDC which would not permit it to take care of all of its operating costs, such costs as you indicate and also service its debt, the member companies would be called

[793]

upon to make good on such guarantees. So in effect we have a reserve of $15 million for contingencies not reflected in these figures which could be used as against any additional costs that are not reflected here.

In other words, if our operating expenses were so much higher than are indicated here or some other element of cost such as you suggest entered into our operating cost we would be in the position of possibly not being able to take care of the repaying of our debt. In that event we could call upon our member companies to take care of the repayment of the debt, and to the extent that we have provided for it in these estimates such funds would be available to meet other operating costs.

Q. You will be paying off principal on the long-term bank loans, will you not, at the rate of $2 million a year beginning with 1964? A. That is right, and I think it is a higher figure in the last year.

Q. With a higher figure the last year, that is right. To the extent that that principal is paid off the member companies will have been relieved of the obligation under their guarantee? A. That is right.

Q. So by the beginning of 1970 their aggregate obligation will be only $3 million and not $15 million?

[794]

A. Yes. That is a very excellent point. It is a decreasing reserve, in other words, Mr. Morrisson.

Q. I again ask you, sir, supposing something untoward should happen which resulted in the destruction or in rendering unusable this inventory of special nuclear material in the year 1970; what provision would be made to take care of the obligation to the Commission for the charge for this loss of material? A. I can not say at this time, Mr. Morrisson. That is something I would like to discuss with my associates. I think it is a condition we would have to meet at the time, depending upon the circumstances at the time.

Q. You are aware, are you not, that one of the Commission charges for special nuclear material under Section 70.23 of the regulations is a charge for the use, consumption or loss of the material? A. Yes, so I understand.

Q. So as the testimony stands at present you do not know what provision the company has made to meet this charge should it arise? A. Not in the event of the loss or destruction of a substantial portion of the inventory.

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[826]

By Mr. Morrisson:

Q. Mr. Acker, I would like to come back once again to the question which we were discussing before as to the possibilities that might arise here either that the construction estimates will be exceeded or that the operating

situation will be less favorable than it has been shown to be on these various exhibits which have been submitted. I think we agreed that there are some possibilities that either of these events might occur. A. I think there are possibilities.

Q. Can you tell me as specifically as you are able to, what discussions have been had with the member companies with respect to the possible demands that might be made on them for additional contributions? A. Mr. Morrisson, all of the people who are involved in this project representing their individual member companies are corporation executives. They deal every day with the possibilities of things that may happen in the future. They have to project their businesses into the future to determine what additional financial support they have to get, what their operating results may be, whether they can support the additional investment which must be made in the business. We are all aware of the fact that this is a more difficult field in which to prognosticate the future than the field in which we are doing business. We have many times discussed the possi-

[827]

bilities that there may be additional demands made on us, but nobody has made any commitment as to what he would do under those circumstances. That is a contingency which we expect to meet when it arises, and my own personal conviction is that this group will go forward in support of this project and see it through to completion.

* * *

[841]

Q. No, no. I didn't make my statement clear. I said that your calculation was based on several assumptions. I will say your calculation was based on several considerations, one of which was the current price paid for plutonium, a second one of which was this $12 guaranteed price of January 1, 1962. Do you recall that testimony? A. I do not, Mr. Sigal. I think whenever I talked about our estimates of plutonium revenues I have always said

[842]

that our assumption and our only assumption was that the current price schedule which is now classified would be maintained and available to us throughout the entire ten-year operating period.

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[843]

Q. Then please explain your position, Mr. Acker. A. I have said several times that our assumption was that the present schedule of plutonium prices, classified, would remain in effect and would be available to us during the ten-year operating period.

Q. You made that assumption in December 1956? A. Yes.

Q. Although you knew at that time that AEC had made an announcement to the effect that the guaranteed price for plutonium after July 1, 1962 would be $12 per gram, is that right? A. That is right, Mr. Sigal.

Q. What reason did you have to believe that PRDC would receive a sum different than the $12 guaranteed price after July 1, 1962? A. We had no reason to believe that that can be demonstrated. That is an assumption, as I said originally, that we made.

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[849]

Q. Did you discuss with any individual member of PRDC what such member would do in the event the funds committed or guaranteed for PRDC would not be sufficient to meet its expenses? A. Yes. I discussed it with many of them.

Q. Can you name the individuals with whom you discussed it and the nature of the conversation? A. I think if you will look at the names of the members, the trustees of PRDC, that would be my answer.

Q. You discussed it with every one of them?

[850]

A. I have discussed it with them as a group. I have discussed it with many of them individually.

Q. Was there any conclusion drawn on the question of what they would do in the event there was not enough money to meet the obligations of PRDC over and above the contributions and the guarantees? A. None whatsoever, but I felt it my duty as chairman of the financial committee, Mr. Sigal, to point out to them this possibility. The schedules themselves show need for temporary loans, and they are all on notice that we may ask them to advance funds to take care of such temporary borrowing.

Q. But none of them said to you what he would do?
A. None of them made any commitment whatsoever.

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HANS A. BETHE

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[1145]

Cross Examination by Mr. Sigal

Q. Dr. Bethe, I call your attention to the following colloquy between Mr. Cannon, Chairman of the Appropriations Committee, and Mr. Strauss, Chairman of AEC, which appears

[1146]

in the same volume at page 239. A. Yes, I have that.

Q. In order to get the context, I would like to read Mr. Cannon's statement first:

> "Let me ask this. We discussed yesterday in exhaustive detail the roadblocks and bottlenecks in the negotiations in order to get Detroit Edison into construction of this fast breeder reactor. Here is another cause for delay, and it was not mentioned to us. I cannot understand why it was not mentioned to the committee when we were discussing these other causes for delay. Furthermore, we discussed yesterday the danger connected with the possibility of these plants getting out of control. We discussed that in detail, and still we are not told what was the cause for failure to approve designs of this plant

that we are so anxious to get along with. Why was this not mentioned to us, Mr. Chairman?

"Mr. Strauss: It was. It was stated that this fast breeder was the most hazardous of all the reactors."

Do you have any comment on the statement of Mr. Strauss?

Mr. Claytor. I object to a question of "Do you have any comment on a statement".

The Presiding Officer: I think so, Mr. Sigal. I will sustain the objection.

[1147]

By Mr. Sigal:

Q. In the light of these statements, Dr. Bethe, are you inclined to make any change in the testimony that you gave with respect to the hazards of a fast reactor? A. No, I am not inclined to make any changes. I did mention in my written testimony various areas in which special investigations are needed for the safety of fast reactors. Similarly the Safeguards Committee letter of June 6 mentions various areas. These are essentially identical. Obviously there are areas which require special attention. Obviously these areas have to be dealt with, although I have no knowledge whether this is so, I presume the gentlemen who have made such comments as you mentioned have in mind that these various areas have to be cleared up in detail.

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KENNETH E. FIELDS

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[2705]

Cross Examination by Mr. Sigal

By Mr. Sigal:

Q. I was going to get to the second point of that answer, Mr. Fields. Aside from any published regulations, are there any kind of standards, criteria, considerations, published or unpublished, which the AEC has established to assist in determining whether or not an applicant is financially qualified to engage in the proposed activities? A. I have a problem on that question, on informally. I don't see how a standard could be established if it is informal. We will use our judgment on the financial qualifications in line with this particular regulation. Now whether this is informal or how you term this, I presume that we will do so on the basis of this record, using our best judgment and opinion as it is developed in this hearing, and to set these matters down as a regulation I doubt whether one could do this in too great detail. One will always rely on judgment in arriving at these findings and determinations on this point.

But in any event, insofar as I know, there are no other regulations by which we currently have in hand to make this determination.

Q. Then I gather you also stated there are no written criteria, whether in regulation form or otherwise, which would be applied by the Commission in determining financial qualifications of applicants.

[2706]

A. I am not aware of any; no.

Q. In regard to section 50.60(C)(2), which I mentioned

earlier, that section states that in order to obtain approval of the Commission of an application, the applicant be financially qualified to assume responsibility for the payment of Commission charges for special nuclear material, and to undertake and carry out the special use of the nuclear material for a reasonable time.

What standards, if any, has AEC established in order to determine the financial qualifications of an applicant under this section? A. Here again I believe the answer is the same. I am not aware of a written, published or otherwise set forth standard for judging this. It is again a review of the specific license application and the judgment issued at the time as to the qualifications.

Q. When you say at the time, you mean at the time that the license is issued? Is that what you mean? Or at the time the application is considered? A. It may be a judgment then or when the actual transfer of the material is to take place; yes.

Q. Are you finished with your answer? A. Yes, I have finished.

Q. Then with respect to the time of the determination, you say that with respect to the transfer of nuclear materials,

[2707]

the determination will be made and the criteria established either at the time the application is considered or at the time the nuclear material is transferred.

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[2743]

By Mr. Sigal:

Q. Certainly it is true, is it not, that AEC has not es-

tablished any guaranteed price for plutonium based on its fuel value for the period after June 30, 1963. A. That is correct.

Q. Now, Mr. Fields— A. Could I put something on this further point to clarify my previous answer?

Q. Surely. Go ahead. A. I think the record should show that this belief on my part as to where the value of plutonium may go does not rest alone on any technical knowledge I have, of the nuclear fuel processes. Essentially this is not a belief based on any technical qualifications I have as a nuclear scientist or nuclear engineer, but on the belief that if it proves to be of value in nuclear power plants that there will be many other factors that determine the value in relation to other materials as well.

Q. Assume that the record shows, Mr. Fields, that if PRDC receives only $12 per gram for the plutonium which it expects to produce in this reactor it will be many millions of dollars short of the income it needs to operate the reactor, does AEC have any criterion applicable to this circumstance for the purpose of determining whether or not PRDC is financially qualified to operate the reactor?

[2744]

Mr. Morrisson: Objection.

Mr. Sigal: This is an entirely different matter from what we considered before.

Mr. Morrisson: It still goes to the question whether there are any criteria on the issues of financial qualification other than those already set forth in the published regulations of the Commission. That has been answered many times.

Mr. Sigal: I would like to have an answer for the record.

The Presiding Officer: I think he will testify that there is no criterion outside of those published in the Federal Register.

The Witness: That is true.

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[2753]

Q. Is there any agreement or arrangement of any kind between AEC and PRDC relating to the charges which AEC will make for the use of special nuclear materials after June 30, 1960? A. Just a minute. The charges we will make to PRDC for the use of special nuclear material?

Q. Specifically for the uranium which you will deliver to PRDC. A. There is a provision in the contract that waives the use charge for five years, I believe, of the operation of the plant, after a license is issued to operate.

You are perhaps not referring to this?

[2754]

Q. I want to make it clear. I am asking now for the period after the period of the waiver. A. I know of no agreement for anything beyond what is in the contract on that waiver provision.

Q. The contract makes a provision for the waiver of use charges? A. Yes.

Q. For the first five years after the license is granted? A. Yes.

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C. ROGERS McCULLOUGH

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[2999]

Cross Examination by Mr. Morrisson

Q. Dr. McCullough, there has been a great deal of discussion in this proceeding about the whole problem of evaluation of reactor hazards, the special techniques and special problems which have been presented by such evaluation.

I would like to include in the record a statement of your general views on these questions of hazard evaluations, and for that purpose I would like you to look at the transcript of the hearings before the Joint Committee on Atomic Energy on Governmental Indemnity for Private Licensees and AEC Contractors Against Reactor Hazards, at pages 47 and 48, the passage that I have marked, and ask you if you still agree with the views expressed in that passage?

[3000]

Mr. Morrisson: If he says that he does, Mr. Examiner, then I would like to have that passage read into the record as a portion of Dr. McCullough's testimony, rather than take the time of asking specific questions addressed to this point, because I think it well expresses the point I am trying to get at.

The Presiding Officer: Very well.

Mr. Morrisson: For reference, I am starting at the middle of page 47 and carrying through to the second full paragraph on page 48.

The Witness: Do you wish me to read this to myself?

The Presiding Officer: Yes, sir.

Mr. Morrisson: Just to be sure that you concur now in the views expressed in that passage.

The Witness: I accept this.

The Presiding Officer: Let Mr. Maslowski see it, please.

In order to save time, the statement may be incorporated in the record at this point, if that is agreeable with you, Mr. Morrisson.

Mr. Morrisson: Yes, Mr. Examiner.

(The information referred to is as follows:)

"Dr. McCullough: I think this is the right attitude, sir.

[3001]

"Care must be taken to insure that there is a low probability of accidents with nuclear reactors because these machines store fission products. I think it is worth reiterating that these products are more toxic per unit weight than any other industrially known materials by a factor of a million to a billion. It depends on what standards you take. If these materials should be permitted to escape there is a possible hazard to large numbers of people and many square miles of territory.

"Because of this possibility of a major disaster, even though it has a low probability, it is justifiable to take unusual precautions that the design, construction, and operation are sufficiently conservative.

"I think it is worth while pointing out that for

the first time in any major industrial development an attempt is being made to foresee the possible accidents or disasters, and to take positive steps to prevent them. The introduction of this new philosophy poses difficult problems. But because of the potential hazard to people, and even future generations, it is imperative to face and solve these problems.

"It should be made clear that the hazards associated with nuclear reactors or any other peaceful application of atomic energy are related to the highly toxic

[3002]

radioactive materials which are generated.

"These facilities that we are talking about do not have an explosion hazard in the sense of a possible detonation which would devastate large areas by blast or heat effect.

"The nuclear reaction is an extremely dynamic one. A nuclear reactor can increase in power level thousands of times in a fraction of a second if it is improperly designed and controlled. There is no other machine that I am aware of that has this possibility of such sudden changes in energy output.

"As a result, fuel elements, control elements, and the structure of the reactor itself can be melted or even vaporized if a nuclear runaway accident should happen. By the proper careful design and the inclusion of reliable controls and safety devices,

it is believed that nuclear runaways can be prevented or, at least, reduced to a very low probability.

"One must recognize that the best known devices are not infallible. Even such well-known things as railroad rails break, turbine shafts shatter, trolley wheels come off and locomotive braking systems fail. One must admit that there is always a possibility that a reactor accident can occur.

"The dynamics of a nuclear reactor are such that

[3003]

if a nuclear runaway is once started no human being can respond rapidly enough to stop it. However, reactors can be designed to be self-limiting. Precautions in maintenance and operation can be taken. The reactor thus can be prevented, in all probability, from ever starting a nuclear runaway."

* * *

MARK MILLS

* * *

[3278]

Cross Examination by Mr. Sigal

Q. Do you see anything urgent so far as either the nuclear aspects are concerned or the social aspects are concerned that this schedule be adhered to. A. I have a feeling this is really outside of my competence, but let me answer a little bit indirectly. Practically all advanced technological developments take place with a sort of combined

construction and research and development and necessary dovetailing of these things and it seems to me that just how this is done really pretty much has to be left up to the people doing it. They are the ones who can see the best ways to schedule different parts of the job in view of development information they see coming along that will influence, in view of the fact some parts of it are not sensitive to the kinds of information that they believe is likely to be developed and pertinent and so on.

* * *

[3285]

Mr. Morrisson: Mr. Radley, will you take the stand, please.

H. MONROE RADLEY was called as a witness and having been first duly sworn, was examined and testified as follows:

Direct Examination by Mr. Morrisson

Q. Will you state your name and address for the record? A. H. Monroe Radley, 3701 R Street, N. W., Washington, D. C.

Q. Are you the H. Monroe Radley who prepared narrative testimony consisting of nine pages which was recently filed in the proceeding? A. I am.

Q. Mr. Radley, will you look at page 2 of that testimony on the first line. It states "From 1942 to 1948 I was an engineer" and so forth. Are those dates correct? A. That should be 1943.

Q. 1943 to 1948? A. That is correct.

Mr. Morrisson: Mr. Examiner, the date was

changed in ink on the copy that was filed with the reporter this

[3286]

morning. I neglected to call attention to it at that time.

The Presiding Officer: Perfectly all right.

Mr. Morrisson: That is all I have.

The Presiding Officer: Very well. Mr. Sigal, you may cross examine.

Cross Examination by Mr. Sigal

Q. Mr. Radley, on page 6 of your statement, you say that PRDC appears to you to have under estimated the cost of on site labor. A. Yes, that is true.

Q. You give your reasons for your conclusion. Can you give us some statement of the order of magnitude of the under estimation of that labor cost? A. I think that is where a considerable portion of the overrun is found.

Q. The present estimate of on site labor is about $3 million, isn't it? A. I believe it is $5 million.

Q. I am sorry, yes. A. $5,235,000.

Q. In your view it is an under estimate by some substantial figure? A. Yes.

Q. Is it two million, three million?

[3287]

A. I am not prepared to say the exact amount.

Q. But nevertheless it is substantial with reference to the total amount of the estimate of on site labor. A. Yes, that is true.

Q. And you point out that your conclusion is based on the ratio of on site labor to total labor cost as shown by the construction of similar projects by AEC. How many projects are you familiar with in the AEC program? A. You mean reactor projects?

Q. Yes. A. I have all construction program.

Q. I see. In so far as the rest of your entire experience with AEC is concerned, both general construction and construction of reactors, what does your experience show with reference to the ratio of on site labor cost to total construction cost? A. Let me put it this way. Here we have a ratio of $18,233,000 for material and $5,235,000 for labor. Usually the labor portion will run much higher than that on projects of this type.

Q. You have a ratio here of say 18 to 5. A. Yes.

Q. Can you give us the ratio that you found to be the case in your construction experience otherwise? A. Sometimes it runs as high as six to four or

[3288]

something like that.

Q. That is six for total construction cost to four for on site labor? A. Yes. This depends on how the accounting is carried on. Different construction firms and estimators carry on accounting in different manners. So that one can't be too precise about these ratios.

Mr. Claytor: Excuse me, Mr. Sigal. You said we were talking about a ratio of six to four, and I think the record is quite unclear as to whether we are talking about six material to four labor.

The Witness: Yes.

Mr. Claytor: Or six total to four labor. It was

used one way one time, and another.

The Witness: Six material to four labor.

By Mr. Sigal:

Q. Would you say this ratio of six to four would be most common in your experience with AEC? A. I would prefer to say it is not unusual. A lot depends, as I said, on how the accounting is carried on. I really could not say that there was any real average.

The Presiding Officer: Does that include the indirect labor, too?

The Witness: The indirect labor down here is in item J on this estimate. This is just straight direct labor cost

[3289]

versus material.

By Mr. Sigal:

Q. You stated on page 7 that not a sufficient amount has been allocated to indirect and overhead expenses in connection with the construction of this project. You point out that the company has allocated $3 million to cover these expenses.

Can you give us some indication of how much more than the $3 million would be required for this in your opinion? A. Very often ratios of 20 or 25 per cent are shown for that item.

Q. What is the relationship? A. Let me clarify that. The total labor and material in this case amounts to $23,468,000. Very often the indirect and overhead costs will be shown as 20 per cent or 25 per cent, something like that, depending on how these things are defined.

Q. Taking the figure of $23 million as shown here, the overhead and indirect expenses on the basis of your experience would run somewhere between four and five million dollars, rather than $3 million? A. In many estimates it does.

Q. You state in the next paragraph on page 7 that the estimated cost of engineering and design expenses as shown by

[3290]

the company's estimate is $900,000, and you feel that the estimate should be at least twice as high as the figure used by the company. What do you base your conclusion on? A. Upon engineering costs that have been reported on our projects.

Q. Is there a usual percentage of engineering cost with relation to total construction cost? A. I quite often use 15 per cent.

Q. Was that based on your experience with government projects? A. Yes, that is true.

Q. So if that formula were applied in this case, you would take 15 per cent of $32 million or roughly $5 million? A. The base on which you would apply the 15 per cent would be less than that. You would use the construction costs. The $32 million includes taxes and some other things like that.

Q. So what you would relate that to, then, if you exclude the taxes, it would come to about $28 million, wouldn't it? A. I would have to add some of these items on page 5. I don't know just what the total would be. One might say roughly $27 or $28 million.

Q. Let us assume it is $28 million. Then the engineer-

ing cost according to your estimate would be over $4 million.

[3291]

A. Using this figure that I often use, yes.

Q. I say using the figure of 15 per cent. A. Yes, but I don't want to say that is my estimate for this project.

Q. You say your estimate for this project is at least $1,800,000. A. At least $1,800,000, yes.

Q. At least that. You also say, however, that it is common on government projects with which you are familiar to find that the engineering costs run about 15 per cent of the actual construction cost. A. That is true. The way we carry on our accounting, that is. PRDC may do it differently and that may not apply to PRDC specifically.

The Presiding Officer: How much have they spent already?

The Witness: I don't know. Not too much so far, I don't believe.

The Presiding Officer: I thought it was more than $900,000. Is that figure available?

Mr. Claytor: How much PRDC has already paid to the architect-engineer?

The Presiding Officer: No, how much they have spent for the cost of engineering design and expenses.

Mr. Claytor: I don't believe that figure is yet in

[3292]

evidence.

The Presiding Officer: That is the reason I am asking the question.

Mr. Claytor: I don't believe it is. You mean do we have it. We certainly don't have it right here.

The Presiding Officer: Why don't you dig it out and let us find out what that figure is, if you will? Apparently, Mr. Claytor, this witness does not know, but I would like to have the figure in the record.

By Mr. Sigal:

Q. You point out further on this same page, Mr. Radley, that the company has estimated its waste disposal system at a cost of $34,500. Are you in any position to estimate the cost of a waste disposal system for a reactor of the PRDC type and size? A. Not in a very good position.

Q. Do you think there is anything in the record justifying the company's estimate of $34,500? A. I am sure that is too low.

Q. What experience is there available to anybody with reference to the cost of waste disposal system for a reactor —a nuclear reactor? A. You mean a reactor of this type using sodium?

Q. Of this type or any type. Who would have the experience?

[3293]

A. We have experience on water systems.

Q. Does anybody have any experience on sodium systems? A. I think it is somewhat limited at this date.

Q. Where would that experience be at the present time? Who would have it and what would it be based on? A. There might be a limited amount on the basis—you mean for projects of this magnitude?

Q. Let us start with projects of this magnitude. A. I don't know of any source of information on sodium systems.

Q. Let us take sodium systems smaller than the PRDC reactor. Is there any information available on such reactors? A. I think there is perhaps a limited amount on the EBRI. But I wouldn't think that would be comparable.

Q. Is it correct to say that there is no experience now available either to AEC or anybody else with respect to the cost of a waste disposal system for a sodium reactor using sodium as a coolant? A. By experience, you mean actual cost data on one that has been built?

Q. Yes. A. I don't think there is any cost data on a system for a plant of this size that is available.

Q. So in your opinion PRDC has no basis for that

[3294]

estimate of $34,500? A. I think that was brought out by the testimony, wasn't it?

The Presiding Officer: I think on page 7 he testified it was too low.

Mr. Sigal: He testified?

The Presiding Officer: Yes, he testified it was too low.

Mr. Sigal: I am saying that PRDC has no basis for its estimate.

The Witness: I think Mr. Amorosi said in his testimony there was really no basis for the estimate.

By Mr. Sigal:

Q. In order that we may get some notion of the magni-

tude of the cost, can you give us some indication of what a waste disposal system for a reactor of this type costs? A. For a water system, yes. On the PWR we are spending about $3 million.

Q. $3 million for the pressurized water reactor? A. That is a round figure.

Q. For the disposal system of the shippingport reactor? A. That is my information.

Q. As far as you know, is there any reason to expect that the cost of a waste disposal system for the PRDC reactor would be any less?

[3295]

A. I think so.

Q. To what extent? A. I don't think the problem is perhaps as acute, although I am really not an authority on waste disposal systems.

Q. But so far as your available experience on the cost of waste disposal systems is concerned, you do have this information with respect to the pressurized water reactor? A. Yes, I have that.

Q. And that shows $3 million. A. Roughly.

Q. Is that system completed now? A. It is under construction.

Q. So that $3 million even there is an estimate or is that a fixed figure? A. I think it is a fairly firm estimate.

Q. You say on page 8 that the company has allowed only $17,200 for miscellaneous parts and in your opinion this should be 20 to 25 times higher. So can we say roughly in your opinion the figure would be around $400,000? A. Three to four hundred thousand dollars, something like that.

Q. Then in the same paragraph you make reference to the $100,000 allowance for plant equipment adjustments, which should be doubled, and you said this should be doubled or

[3296]

tripled. Can you make a choice there? Can we quadruple it for the sake of variety? A. I think the testimony ought to stand the way it is.

Q. You will put it between two and three hundred thousand dollars? A. Yes, something like that.

Q. Then the next paragraph on the same page, you say while it is difficult to point out line items in the estimate which appear to be out of line from your experience, you nevertheless point out some of them, which are estimated at too low a figure. Can you be a little more specific about the particular items you have mentioned? You say, for example, that $30,000 for heating, lighting and ventilation is too low. What would be nearer to the probability as you see it? A. Ordinarily for buildings of this type, heating, lighting and ventilation will run 20 to 30 per cent. I think this particular building will have to have a fairly costly ventilation system.

Q. That is 20 to 30 per cent of what? A. Of $423,000. That may be somewhat high, though.

Let me correct that and say 15 to 20 per cent.

Q. So that the cost at the minimum in your opinion would be around $75,000? A. Yes, perhaps.

[3297]

Q. That would be about 15 per cent. So far as the figure for the element decay and storage building is con-

cerned, are you satisfied with that figure? You did not mention that as one of the items which you underestimated. But I wonder whether you considered that in connection with the other.

The Presiding Officer: What was that figure?

Mr. Sigal: The $428,000 figure.

The Witness: I have no information on the size of that structure at all. There is a sketch in APDA 115 and this estimate, so it is a little difficult for me to say much about whether it is too small.

By Mr. Sigal:

Q. The next item mentioned is the cost per cubic yard for the concrete work around the reactor. Is that item included in another figure or didn't you just give any figure for that at all? A. That is given in Acker Exhibit 7.

Q. Yes, but I mean you don't state any figure for it. A. The figure is $57 a cubic yard for the reinforcing steel and forms. My experience is that concrete around a reactor will cost considerably more than that. Several times that figure.

Q. Several times $57? A. Yes, depending on conditions. I don't know too much

[3298]

about this job as to the details. I just have these sketches. But it could easily cost $125 or $150 a yard for this particular concrete.

Q. So what does it come to? A. I really don't know. I made up no amount for that.

Q. Does the exhibits give the number of cubic yards?

Mr. Claytor: Could I ask if we are talking about

item B-1 in Acker Exhibit 7, just to be sure which concrete it is?

The Witness: Yes, that is the concrete I am talking about.

The Presiding Officer: Is that the hot cave?

Mr. Claytor: Reactor foundation, vessel foundation and external concrete work.

The Witness: 2,130 cubic yards.

Mr. Claytor: I beg your pardon. That is item B-3.

The Witness: You are right.

Mr. Claytor: That is why I was confused as to whether it was item B-1 or B-3.

The Witness: It is the internal work around the reactor. That is B-3.

Mr. Claytor: Just to clarify this, if I may, Mr. Radley, this entire item is estimated at $1,488,400.

Mr. Morrisson: Mr. Chairman, may I ask if the witness has this exhibit before him?

[3299]

The Presiding Officer: He may have it.

The Witness: Yes, it is Acker 7.

Mr. Sigal: I thought he had it.

Mr. Morrisson: I wanted to be sure.

By Mr. Sigal:

Q. Is that correct? A. That is correct, with contingencies.

Q. Yes. On the basis of your estimate what would that figure come to, or which item in that group of figures would you change? A. I would increase the allowance for concrete.

Q. From what to what? A. I really have not intended to increase. I merely point out this as one of the items in the estimate which appears to be low to me.

Q. In any event, as far as this particular item is concerned, you would say that the cost would be two to three times as high as they estimate? A. Just the concrete, which is really not a large part of this.

Q. Just the concrete? A. Yes.

Q. You don't make any comment on the rest of it? A. Not on the total amount.

The Presiding Officer: Isn't it a fact that they have

[3300]

under estimated everything here in Acker 7 with relation to these costs? I read your testimony and I was concerned a little bit because it looked as if they were under estimating everything.

The Witness: I don't mean to give that impression that everything was under estimated.

The Presiding Officer: A lot of things. There is a lot under estimated in that Acker exhibit, is that right?

The Witness: Yes, that is the burden of my testimony, I presume.

The Presiding Officer: That is the way I read it.

By Mr. Sigal:

Q. The next item you mentioned, Mr. Radley, is the hot cave for two cells of $378,200. What would your estimate of that be? A. I really have no estimate for that hot cave, but I think that is low. Hot caves are very difficult to

estimate unless you have all the details. I think for the sort of work they will be dong they will spend more than that for the cave.

Q. Can you give some notion of where it might land? A million? A. Perhaps a half million.

The Presiding Officer: Under estimated?

The Witness: No, the total cost might be half a

[3301]

million dollars, let us say, roughly.

By Mr. Sigal:

Q. Then you go on to say that it is probable many costs have been overlooked since each line item in the estimate has to include certain work related thereto, and is not mentioned or described, and you point out electric wiring between buildings. Did you make any attempt to list the various items which may have been overlooked or under estimated? I mean a more complete list? You have given some examples. I wonder if you would try to be more exhaustive? A. I could give a few more examples. I think the core will turn out to be under estimated.

Q. What do you have to say about that? A. The amount given seems low for a project of this size by comparison with other cores.

Q. To what extent? A. I really have no idea as to what it will cost.

Q. Can you give us your experience with other cores? A. Cores can cost as much as $10 million.

Q. I am sorry. A. Cores can cost as much as $10 million.

Q. What does this estimate show for PRDC? A. $205,000.

Q. Are you in any position to give any more specific figure for the PRDC reactor on the basis of your

[3302]

experience? A. No. I can't go beyond saying that the amount given seems low to me.

Q. What other items have been under estimated? A. Item B-2 in Acker 7, containment vessel, shows an allowance for extras for air lock doors of $30,000. I think that is quite low. Air locks are quite expensive; and I am sure that the $30,000 is inadequate.

Q. What is your experience with air locks as to cost? A. I would say for this project they may cost between one hundred and two hundred thousand dollars.

Q. Any other items? A. That is all.

Q. In your opinion as your testimony has indicated, there are probably many other items which have been either overlooked or under estimated? A. I think that is true.

Q. You state at the bottom of page 5 of your testimony that the nuclear portion of the project will cost several million dollars more than $32,400,000 estimated by PRDC. If we add up simply the estimates you have made with their qualifications, on the specific items mentioned, it would appear that the under estimate is somewhere in the neighborhood of four to five million dollars. Would you say that is a fair statement, Mr. Radley?

[3303]

A. The testimony I have offered lists a number of items which support my opinion that the reactor is under estimated. But these various examples are not intended to add up to give an overrun.

Q. I know you did not intend them, but I am trying to draw some conclusions. Obviously this all relates to cost, and your figures must be used and examined with all flexibility that you have suggested they should possess. But nevertheless your testimony shows that with respect to site labor, the under estimate runs into millions. The same thing with reference to overhead expenses, and also the waste disposal system. We can go on with these various items. Certainly to say that the total has been under estimated by five million dollars is being very conservative, isn't it, Mr. Radley? A. I think I have gone about as far as I am prepared to go on the basis of the information I have when I use the words several millions.

Q. Several millions is anywhere from three to ten, isn't it? A. The dictionary says more than two, but not many.

Q. Are you familiar with the speech that Admiral Rickover gave recently on the matter of engineering problems and so forth, and the manufacturing problems with respect to reactors? The speech was discussed in Mr. Amorosi's testimony.

[3304]

A. I don't believe I am.

Q. On page 2, you point out that you have made estimates for many types of reactors and made or reviewed estimates of projects under construction. On the basis of your experience, can you tell us what differences have developed between the estimated cost for construction and the actual cost of construction of the various reactors which have been built by or under the AEC's direction? A. The PWR is an example which has gone from $37,750,000 to $55 million.

Q. That is not yet completed, is it? A. It is not finished yet.

Q. Does it appear that the cost will be around $55 million? A. Yes, that is the present estimate.

Q. What other reactors can you mention? A. The engineering test reactor has gone from $15 million to $17 million, but that is not a power reactor. That is a research reactor. The Army package reactor is a fixed price project, so we don't have anything on that.

Q. It is the builder who rules it out on that and not AEC. What about the sodium reactor experiment? A. I have some rough figures on that for the construction portion. From an original figure of $10 million it has gone to $18,5 million.

[3305]

Q. That is still in the process of construction or is that completed? A. I believe it is substantially completed now. Of course, that is a research project. There is a considerable research.

Mr. Morrisson: I believe that reactor has gone critical.

The Witness: That is my understanding. It is substantially completed.

By Mr. Sigal:

Q. Can you mention any others? A. I might mention the boiling water reactor at Argonn which was built substantially for the estimate of $4.5 million. It is now $4.6 million. Those are some examples.

Mr. Sigal: That is all.

The Presiding Officer: Thank you, Mr. Sigal. Mr. Claytor, you may cross examine.

Cross Examination by Mr. Claytor

Q. Mr. Radley, first of all, with respect to the item of miscellaneous spare parts which we discussed a few moments ago, it would be possible, would it not, either to include a very substantial allowance as an initial capital cost for a large initial supply of miscellaneous parts, or it might be possible to include instead a large operating allowance for

[3306]

the purchase of miscellaneous spare parts in your operating budget, with a proportionately smaller initial supply, would it not? A. Yes, you can do your accounting that way.

Q. So that if it were done that way, obviously the amount of initial supply of spare parts to be included in your construction budget would be lower than they otherwise would. A. Yes. The accounting could be carried on that way.

The Presiding Officer: You amortize spare parts, don't you?

The Witness: We ordinarily would include a large supply of spare parts.

The Presiding Officer: But you would amortize them, wouldn't you, over a period of years?

The Witness: I don't know

By Mr. Claytor:

Q. Now I would like to discuss for a moment the figure for engineering design and expenses of $900,000, item P on Acker Exhibit 7. I think you said that it would be realistic to use an estimate for engineering services of

at least $1,800,000 for this. A. At least twice as high as the $900,000, that is correct.

Q. That would be $1,800,000.

[3307]

A. That is right.

Q. You took into consideration, didn't you, that the work called for by this item is to be performed under contract with Commonwealth Associates? A. Yes, I know of that.

Q. In connection with estimating the costs that would be incurred in performing this work, I would like to get some idea of what kinds of costs you assume would be incurred. What kinds of costs would be defrayed by this figure of $900,000 or $1,800,000, the estimated figure? A. You would like to have me tell you what engineering design—

Q. I would like to have you tell me what costs you assumed would have to be covered when you gave the opinion that it ought to be at least twice the figure that we estimated. A. That is what is commonly termed engineering design.

Q. Yes. But what costs are commonly covered by engineering design expenses? A. The cost of making initial working drawings. The cost of making the as-built drawings when the job is completed. The cost of expediting. The cost of inspection of the work which I understand is to be done by United Engineers for a fixed fee. I have taken that into account. Is it United Engineers?

Q. Are we not now mixing up the item for engineering

[3308]

services, erection supervision, which is United Engineers

and Constructors, and design and engineering item of $900,000 which is Commonwealth Associates only? A. No. I am not mixing up anything. United Engineers is doing the inspection. Isn't that correct?

Q. That is right. A. I am not confusing construction superintendence with engineering at all.

Q. I just wanted to be sure. I am thinking about analyzing the costs that would be incurred by Commonwealth Associates in rendering these services. For example, I assume that you have assumed that the cost would then include Commonwealth Associates direct payroll costs of their employees engaged in this work—hourly rates times the number of hours with adjustments for payroll taxes, workmen's compensation and things of that sort. A. What is your question?

Q. My question is, have you assumed that one of the items of cost which would be included in this heading, engineering services, would be the direct payroll costs incurred by Commonwealth Associates for its employees engaged in this work? A. Commonwealth Associates are to do the engineering.

Q. At cost. In order to estimate whether or not the costs are correct, we must know what kind of costs are being defrayed by Commonwealth Associates.

[3309]

The Presiding Officer: Mr. Claytor, let him answer the question now. He is entitled to answer the question.

Mr. Claytor: He is indeed.

The Witness: You say they are going to do it at cost. What do you mean by cost?

Q. It has nothing to do with this figure of approximately $3 million? A. No, they would not be charged in there.

Q. Could you tell what the figure of $3 million which you say is not sufficient for indirect and overhead expenses, what type of work you have assumed is covered by that figure?

[3312]

A. Just what is given back here in item J. That is all defined. Shall I read it?

Q. If you mean the two paragraphs under J? A. Yes.

Q. You have assumed that this figure is to cover that work? A. Yes, that is what is stated here. I would point out there is an et cetera in the first paragraph which leaves me at a little bit of a loss.

Q. You take into consideration that a major portion of the work under J is to be performed by United Engineers and Constructors under a contract, or did you consider that is an entirely separate item? I just want to be sure we understand each other. A. United Engineers and Constructors are doing the inspection which is a phase of the engineering. Is my memory correct that, for $225,000, which hasn't anything to do with this item at all?

Q. I think the evidence—

The Presiding Officer: Does somebody know the answer to that question? Is the witness' statement correct, or do you know?

Mr. Morrisson: I don't recall.

Mr. Claytor: Mr. Acker's testimony in the record, I believe, you will find is to the effect that United

[3313]

Engineers and Constructors are to perform the

services covered under item J of Acker Exhibit 7 pursuant to a contract. That of this item of $2,977,000 approximately $225,000 is to be fee to United Engineers and Constructors pursuant to the contract.

The Presiding Officer: Let me ask you a question off the record.

(Discussion off the record.)

By Mr. Claytor:

Q. One other question on this item before you put that aside. A. I have not answered that question yet.

Q. We are leaving that aside until we can investigate.

The Presiding Officer: We will straighten it out in the morning that $225,000 figure. I wish counsel would get together on that and agree what it represents.

By Mr. Claytor:

Q. One other question with respect to the figure which you described as indirect and overhead expenses in connection with the construction of the project. I would like to know if you have assumed that there is also included in this item the overhead expenses to PRDC of going forward with the construction of the project. That is to say, such expenses to PRDC of its office, its ordinary office personnel, its supervisory personnel at the office and the

[3314]

field and that type of expense. A. I have not considered this from the standpoint of what does what. You have a capital cost estimate here of $32,400,000, and you have material and labor given in your estimate. It is customary for those items to mean direct charges.

three assistant managers, a secretarial force, one or two contracting officers and two or three people who assist in the expedition of the work. This is on their payroll. A. They correspond with the construction contractor's

[3317]

management staff.

Q. No. Their job would be solely to coordinate the various contractors, primarily it is an office management force. On such an assumption would not the expenses of maintaining such an office force normally fall within this item, an item of indirect and overhead expenses which would be part of the construction cost estimate? A. They might or might not, depending on how the job is handled. Sometimes owners carry on quite an activity in connection with their projects.

Q. If such expenses were included in your indirect and overhead expense item obviously the item would be larger than if all those expenses were not included in the item. A. Is that a question?

Q. That is a question. A. The more you put in the larger it gets.

Q. So that if an item of indirect and overhead expenses does not in fact include the cost of maintaining an office, a number of employees, secretarial service and such, obviously such an item would be smaller in the construction estimate than it would be if those expenses were in fact included, wouldn't it? A. This is an abstract question?

Q. Yes. A. Naturally. That doesn't necessarily apply to this,

[3318]

though.

The Presiding Officer: Mr. Claytor, I think it would be a good time to take a recess until in the morning.

Mr. Claytor: I was going to another item anyway, Mr. Examiner.

The Presiding Officer: Let the record show that we will be in recess until 10 o'clock tomorrow.

(Thereupon at 4:25 p. m., a recess was taken until Tuesday, June 18, 1957, at 10:00 a. m.)

[3320]

The Presiding Officer: The hearing will be in order.

Whereupon,

H. MONROE RADLEY resumed the stand as a witness, and, having been previously duly sworn, was examined and testified further as follows:

The Presiding Officer: You may proceed.

Cross Examination (Resumed) by Mr. Claytor

Q. I have just two or three more questions, Mr. Radley.

Could I direct your attention to Item B-3 of Acker Exhibit 7? When you said, Mr. Radley that, in your opinion, the estimate for concrete work included in this item was low, did you mean that the material estimates per unit volume were low, the labor estimates were low, or that both were low? A. I think it is largely a labor matter here. It is largely labor.

Q. It is largely labor costs included there that were low? A. Yes.

Q. You think, then, that the material costs on that item are about right? A. Well, it is a little difficult. You see, you take this

[3321]

item concrete mix in place. That includes both material and labor. I presume $18 will buy concrete out there. I think it is largely in the labor.

Q. So on that item it is the $10 per unit per cubic yard labor cost that you particularly had in mind? A. Yes.

Q. Now, could I refer you to the next page, Item B-4, the sub-item heating, lighting and ventilation? Could you give me some idea of what proportion of that expense you have assumed is heating, what proportion is lighting, and what proportion is ventilation? A. I haven't made assumptions on that basis. I merely took it as a percentage of the total.

Q. As a percentage of the total? A. As a percentage of the total cost.

Q. So that on the basis of the analysis you have made, you couldn't break it down? A. I couldn't do that here. I probably could in my office. I believe I said yesterday that I thought probably the ventilation requirements were underestimated for this sort of a facility.

Mr. Claytor: Mr. Examiner; yesterday you asked me if I could obtain an approximate figure for the amount of engineering services and expenses to Commonwealth Associates that have been paid to date. I have an approximate figure as of

[3322]

the end of May. That is $128,500, out of a total estimated amount of $900,000.

The Presiding Officer: Thank you, Mr. Claytor.

Mr. Claytor: That is all I have, Mr. Examiner.

The Presiding Officer: Is there any re-direct of this witness?

Mr. Morrisson: I have one or two questions, Mr. Examiner.

Re-direct Examination by Mr. Morrisson

Q. Mr. Radley, do you have a copy of the transcript of the testimony which you gave yesterday? A. Yes.

Q. Will you look at page 3300, at the question of the Presiding Officer beginning at the bottom of 3299. Your answer says "I mean to give that impression that everything was underestimated."

I wonder if a negative was left out of that answer. A. I intended to say yesterday, and I think I did say, "I don't mean to give the impression that everything was underestimated." I think the word "don't" was omitted in error there, in the transcript.

Q. In other words, your position is that there are a number of specific items in Acker 7 which you regard as being underestimated, but not that everything in Acker 7

[3323]

is underestimated? A. That is correct.

Q. And that you also regard the over-all figure of $32.4 million as underestimated? A. That is correct.

Q. On the following page, 3301, you refer to the core

By Mr. Clayton:

Q. We have a contract with Commonwealth Associates of which you are aware. A. Yes.

Q. The contract is not for a fixed fee but provides that the work will be performed at cost. Now, what I am trying to do is to find out what costs you assumed in saying the figure should be at least $1,800,000. What costs you assumed would be defrayed by this figure of $1,800,000. A. The cost of Commonwealth Associates' engineers, plus overhead, plus Commonwealth Associates' overhead costs.

Q. So you have assumed what we would be defraying here would be first—I am trying to do it in a little more detail—payroll costs of Commonwealth Associates. A. I don't think we are getting anywhere in discussing Commonwealth Associates accounting procedures. I said engineering would run around $1,800,000 at least.

Q. I am trying to test the basis on which you have reached the figure of $1,800,000, since the figure

[3310]

necessarily, Mr. Radley, on the basis of the evidence already in the record depends upon the costs to Commonwealth Associates. In giving the opinion that the costs would be at least $1,800,000, you must have assumed that certain expenditures by Commonwealth Associates would have to be covered by the $1,800,000. I am trying to explore what expenditures by Commonwealth Associates you assumed would be covered. A. Engineering costs. Maybe I can answer it this way. Engineering costs consist basically of two things. One is the direct charges and the overhead charges.

The Presiding Officer: Let him answer the question.

Mr. Claytor: I thought he finished, Mr. Examiner.

The Witness: I finished.

By Mr. Claytor:

Q. So direct expenses of doing the work including payroll, including out of pocket expenditures for travel, and so forth. A. Travel, telephone, expediting.

Q. Plus a fair share for overhead allocable for the job. A. That is the usual practice.

Q. How about a reasonable fee or profit to the engineering firm? A. You just said profit is not included in here.

[3311]

Q. I am asking you. I think the evidence is silent about whether the profit is included or not. I am trying to find out whether in giving your opinion that the figure should be $1,800,000 you assumed that figure of $1,800,000 would include in accordance with normal practice a reasonable fee or profit to Commonwealth Associates. A. I presume so, because when I said 15 percent included for engineering is a rough percentage, actually the profit on these engineering contracts is not of sufficient importance to make much difference one way or another.

Q. Now I would like to turn to another item, the item which you describe in your direct testimony on page 7 as indirect and overhead expenses in connection with the construction of this project. It is your assumption, is it not, that this is to include the construction engineering supervision by United Engineers and Constructors? A. I think we better look at the testimony on United Engineers. I think they are just doing inspection on this for $225,000, which hasn't anything to do with this at all.

Q. That is right. A. To which there are certain indirect costs which are given here as $2,977,000.

Q. That is right. A. That is a standard construction accounting procedure. Regardless of who does that, these costs are going too low.

Q. And in accordance with standard construction and accounting procedures, one of the indirect costs that would be included in a figure such as this would normally be the ordinary indirect overhead expenses of running whatever office has to be run, having your own employees supervise to the extent that they do supervise your actual construction, consultation with your contractors, and that type of thing is an item of indirect and overhead expense. That is the only question I have. A. What is your question?

Q. My question is this. In accordance with ordinary construction and accounting procedure, do you include in

[3315]

indirect and overhead expenses, the heading for indirect and overhead expenses, such items as the cost of running the office, the cost of having your own employees coordinate the work of the different contractors and what I would call general overhead..

The Presiding Officer: Mr. Claytor, it can't be both indirect labor and overhead. It has to be one or the other now.

Mr. Claytor: The way he describes this item in his testimony, Mr. Examiner, is indirect and overhead expenses. My inquiry is to find out if the type of expense which I have described is normally covered under that heading.

The Presiding Officer: It cannot be indirect labor

and overhead at the same time. It has to be one or the other.

Mr. Claytor: This is so. I am asking whether it is considered to be an indirect expense or an overhead expense, either or both.

The Presiding Officer: That is a fair question.

The Witness: The question in accounting terminology I would say this item includes both indirect and overhead costs.

By Mr. Claytor:

Q. By which you include the types of expenditures I have just mentioned.

[3316]

A. Right here on J the whole thing is spelled out.

Q. My difficulty, Mr. Radley, may partly be with the description in J. The description in J does not specifically mention such items as the cost of renting an office, for instance, the cost of maintaining supervisory personnel on the payroll, and I would assume that if there are such costs in connection with the construction of a project, regular construction and accounting procedure would call for those costs to be included in an item such as this. A. That is my understanding of J.

Q. Thank you. A. Let me correct that. I don't want to say that what you said is right. I want to say that item J describes their costs.

Q. Yes, I understand that item J describes our cost. I still feel we must clear up this. Perhaps I can get at it this way.

Let us assume that a reactor construction project from the beginning of construction has on its payroll a manager,

as being possibly underestimated. In the first place, you stated the core estimate as $205,000. Is not the actual figure on Acker-7 somewhat higher than that, when one takes into account installation cost and contingencies? A. Yes. I was speaking from memory. The 205 is for the fuel elements only, I believe.

Q. Do you have the actual installation cost? It is 300-and-some thousand, isn't it? A. I think it is about 335,000, installed.

Q. You stated in the lower part of page 3301, that cores can cost as much as $10 million. Did you mean in so stating to imply that you thought the core for this reactor might cost as much as $10 million? A. No, I did not.

Q. Mr. Radley, you have stated in your testimony in rather general terms that you believe the construction cost had been underestimated by several million dollars. Are you prepared to give an estimate as to what you believe the construction of this project will cost?

[3324]

A. No, I am not.

Q. Can you indicate why you do not feel in a position to give a specific estimate on this construction cost? A. It is because of the lack of information on the project, the uncertainties that remain.

Q. In other words, you do not feel that the opportunity that you have had to review this project, the information that has been available to you, has placed you in a position in which you could give the kind of estimate that you would normally be expected to give on a commission project, is that right? A. That is true.

Q. Do you believe it is possible that this project could

be constructed for the estimated cost of $32,400,000? A. I do not.

Q. Mr. Radley, as I understand the record, there is an excess available to the company of a little over $2 million between what the company has stated as its cash requirements, and the funds available to them through commitments and loans.

Let me explain how I arrive at that figure.

Mr. Acker, at page 16 of his written testimony, states the cash requirements at $36,216,000. This is arrived at by deducting from the total cost of $43,216,000, an amount of $7 million which is stated to be a contribution by APDA. That figure of $36,216,000 is less by a little more

[3325]

than $2 million than the total of commitments of $23,540,000, and bank loans of $15 million, to all of which Mr. Acker has testified.

So there is a difference here of somewhat more than $2 million.

Do you believe it likely that the construction cost of the reactor will exceed the estimated cost by more than $2 million? A. I do.

Mr. Morrisson: That is all I have.

The Presiding Officer: Is there anything further of this witness?

Mr. Sigal: Yes.

Re-cross Examination by Mr. Sigal

Q. You have stated that you do not have sufficient information to enable you to give a specific estimate on the total construction cost, is that right? A. Yes.

Q. Can you state what additional types of information you would need from PRDC in order to arrive at a specific estimate? A. I can give you sort of a general idea.

Q. That is all I am asking for, yes. A. The sketches in the APDA-115 are not adequate, for one thing, to show the size of the buildings. They are not

[3326]

described very completely. There are not very many dimensions anyplace. There are a great many uncertainties as to what is required in the project. There is a general lack of information throughout.

Q. When you say a general lack of information, you are now talking about the design of the building? A. Well, that is just an example.

Q. Yes. All right, are there any additional types of information that you could get from a report, say, on their accounting procedures? Would you want that? A. That would be helpful, too, yes.

Q. Do you think that there is enough information provided now to determine what the operating costs would be? A. I am not qualified on operating costs.

Q. Would you not want the same types of information with respect to overhead, indirect costs, and so forth, with respect to operating costs and accounting as you would for construction costs and accounting? A. I say, operating costs are out of my field.

Mr. Sigal: That is all.

The Presiding Officer: Is there anything further of this witness?

If not, you may be excused. Thank you, Mr. Radley.

Q. And you are assuming an increase in all your other costs, all your other prices, at 4.2 percent a year? A. Not necessarily 4.2 percent a year, Mr. Sigal. That is on the basis of the escalation formula provided for in the schedule for the price of plutonium.

Q. The escalation is based on the increase in the BLS cost of living figures? A. That is right.

Q. Can you estimate that there is going to be this increase in the price of plutonium over this ten-year period? A. I certainly can estimate it, yes.

Q. I mean, what is the rational basis of your conclusion that the prices are going to go up at the rate of 4.2 percent a year? A. On the basis of the trend from 1955 to date. That is the best thing I know of.

Q. You think the prices will continue to go up yearly on that trend? A. I think it is a realistic assumption for this purpose.

Q. Nevertheless, you have not taken that trend into consideration with respect to any of your construction and

[3437]

operating cost, or prices other than plutonium, have you? A. Yes. Not that exact 4.2 percent, no.

Q. What figure have you used? A. We have escalated coal cost as the basis for our steam revenue.

We have escalated, we have provision for escalation on labor and our construction estimate.

And I would have to refresh my mind as to the other elements of our either construction or operating costs which we have included escalation in.

Q. Do you have provision for escalation of your pro-

duction cost throughout the ten-year operating period? A. Some elements of the cost, yes.

Q. What elements of the cost? A. I said I would have to refresh my mind on that, Mr. Sigal. I know that the steam price is escalated.

Q. In regard to your statement here in Acker Exhibit 26, you say that if the plutonium prices are escalated 4.2 percent a year, your income, assuming a basis of twelve dollars per gram, would be $22,422,000 in a ten-year period. A. That is right.

Q. Which would be $10,328,000 less than you now estimate your income to be? A. That is right.

Q. Taking that ten-million dollar difference, have you

[3438]

made any provision for the contingency that your plutonium income would be ten million dollars less than you have now estimated? A. No, because it is a completely unknown quantity as to what the government price of plutonium will be after June 30, 1963.

Q. But it is a fair conclusion, is it not, Mr. Acker, that whether your reduced income is on the order of ten million dollars or eighteen million dollars, PRDC reactor could not operate on the basis of the reduced income? A. No, I will not say that.

Q. You would not say that? A. No.

Q. How could you operate it? A. We could operate it if the member companies felt that it was of sufficient importance to go forward with the project to put up the additional operating funds required.

Q. And, of course, there is not now an undertaking

ABEL WOLMAN

Cross Examination by Claytor

[3357]

Q. Dr. Wolman, in your opinion, does the question of whether or not this construction now goes forward at this site involve any question of public safety? A. It does not to my mind.

Q. It is a question of balancing the expenditures of P. R. D. C's money against the probability that the facility may or may not be permitted to be operated. Is that how you view it? A. That is correct.

Q. Now, Dr. Wolman, you have mentioned both in your narrative statement and this morning a number of items of additional information which you think should be supplied. In your opinion, is this the additional information that is needed in order to enable you to reach the kind of definitive conclusion about the environmental suitability of the site which you should make prior to operation of this reactor? A. That is correct.

Mr. Morrisson: I did not hear the witness' answer.

The Witness: "That is correct."

By Mr. Claytor

Q. On page 18 of your narrative testimony you say, there are "certain specific problems with respect to the proposed site which would have to be resolved before a determination could be made as to

[3358]

suitability of the site even for a reactor whose stability and basic safety had been established.". This is what you meant when you made that statement in effect? A. That is correct.

Q. And is the same true with respect to the statement on page 20 of your narrative statement where you say that no definitive determination with respect to the suitability of the site can be made until certain additional information is supplied? A. That is true.

Q. Now, Dr. Wolman, if adequate information is developed in the categories which you have discussed in your direct testimony and also this morning, will there be, in your opinion, sufficient information to enable you to give a final and definitive evaluation of this site? A. I believe that is correct.

Q. Now, Dr. Wolman, on page 14 of your direct testimony, you say that in your opinion the proposed site would be satisfactory from the point of view of its accident potentiality for a reactor that is inherently safe and reliable if it could be shown that no credible accident can release fission products into the atmosphere. A. Yes.

Q. Again on page 19, you say at the bottom of the page that, based on information available and assuming adequate

[3359]

containment and facilities and procedure for the disposal of waste surrounding populations would probably not be endangered by normal operation. A. That is my claim.

Q. Now, Dr. Wolman, assuming that the reactor is ade-

quately shown to be safe, stable and reliable, and that no credible accident can breach the containment building, would it be fair to summarize your opinion as saying that, although there is not yet sufficient information to enable you to reach definitive conclusions, there is rather sufficient information to enable you to say that this site appears generally suitable from the standpoint of public safety for a reactor of this power? A. With your two assumptions, I would say that that is true with one reservation. I would still want to wait upon the results of the meteorological studies. If they turn out to be very unfavorable, I would then have a further reservation even as to the suitability of the site.

Q. Well, even if the meteorological studies should turn out to be very unfavorable, are there not provisions which could be made which might enable a reactor of this power to be operated on this site? A. I am sure that there are. They would have to again be taken into account. They would have to find their way into the design and construction so as to reduce by another

[3360]

magnitude the possibility or the probability of a release under unfavorable meteorological conditions.

Q. Then the addition of the meteorological condition really means that we must make another assumption before we say that on the information we now have that this site is generally suitable from the standpoint of public safety for a reactor of this power, and that an additional assumption is if the meteorological conditions turn out to be quite unfavorable we may have to make some additional changes in the actual containment or in other protective

measures to make more sure that we will not have release of fission products. A. That is correct. What I am doing is saying that I have substitution values for various things all on the basic assumption that the stability of the reactor is agreed. There are alternatives for added protection where added protection seems necessary at that site.

Q. Now, with the exception of the addifional meteorological information which we have just been discussing, is it true that the additional information which you have indicated should be supplied is of such a nature that it is not likely, in your opinion, to indicate the existence of any new problems or conditions affecting environmental safety which cannot adequately be provided for or protected against? A. It is not likely but I would like my testimony to show that I or my equivalent would have the opportunity for

[3361]

for that ultimate appraisal.

Q. Of course, my question assumes that there would have to be a definitive determination of this question prior to operation. The question is designed to test only the question of probability. A. Well, on the probability, I would say that it is unlikely that there would be disabilities of environment that would work counter to such a decision.

Q. And even the meteorological disability, when we call it that, is one that can be met? A. I think that can be met if understood and if appraised.

* * *

ERNEST R. ACKER (recalled)

[3392]

Cross Examination by Mr. Sigal

By Mr. Sigal:

Q. Mr. Acker, let us assume that AEC does not have an appropriation to carry out its contract, the contract between AEC and PRDC. Will PRDC continue with the construction of the reactor? A. Mr. Sigal, we have been proceeding, of course, under the assumption that the commitment in the contract made by AEC would be supported by appropriation; that is, the commitment to spend $4,450,000 for research and development work on this reactor.

The contract was entered into under the demonstration power reactor program which invited industry to participate with government in the development of nuclear power on a large scale.

We would be disappointed if Congress did not appropriate funds to permit the AEC to go through with its commitment in this contract. We might go out and raise the funds to take care of this research work ourselves.

Certainly this group has demonstrated in everything it has done so far that it has been willing and able to put the money on the barrelhead to met contingencies as they arose and to demonstrate our good faith in going through with this project and I think that we could raise the funds to replace this appropriation if it is not made.

However--

[3398]

Q. Now you state on page 1 of your supplemental, Mr. Acker, that on June 19, 1957, the Executive Committee of PRDC has offered a resolution requesting its utility members to agree to make additional contributions during the year 1961. Do you have a copy of that resolution? A. I have a copy of the minutes of the meeting.

Q. Well, in whatever form you have it. I am interested in seeing a copy of the resolution that was adopted by PRDC. A. I have the minutes of that executive Committee meeting at which that resolution was adopted. Would you like to have me read the resolution?

Q. All right; go ahead. A. And the preamble as well.

Q. I don't know what is in it, Mr Acker, so you proceed and we will ask questions if we are not satisfied. A. This is an excerpt from the minutes of the Executive

[3399]

Committee meeting of Power Reactor Development Company, held on June 19, 1957:

"A discussion was had of the comparative schedule of plant component cost estimates and commitments accompanying the Treasurer's report and a showing with respect to items there covered of an over-run of 7.4 per cent over estimates which include contingency allowance.

"In view of this over-run and in view of the generally rising trend of construction costs, it was decided that this committee can recommend to the trustees that the Company's financial resources be further increased by extending the present 5-year base contribution commitment of utility company members an additional sixth year.

"Accordingly on motion duly made, seconded and unani-

monsly carried, it was resolved that the Executive Committee recommend to the trustees that the trustees request all utility company members to make an additional commitment to PRDC equal to 20 per cent of their prior commitment payable on 30 days demand during the year 1961 and to be evidenced by a supplementary commitment letter prepared in the terms of the attached form.

"This letter shall be supported by authorizing resolutions of each Board of Directors in substantial accordance with the form attached hereto."

Q. I understand, Mr. Acker, that there are two reasons

[3400]

for the request for additional contributions, namely, the information that there was already an over-run of 7.4 per cent in your costs and, secondly, that there is a rising trend of costs in general. A. That is right.

Q. Presumably construction costs, I suppose. A. That is right.

Q. Now, does the requested additional commitment in the amount of $3,908,000 constitute the amount necessary to meet your anticipated over-run? A. We have no anticipated over-run definitely, Mr. Sigal, but this amount that we will realize as a result of this call, together with other free funds which we will have available, will give us, in the opinion of the Executive Committee and the staff, a sufficienty substantial margin of resources over actual construction costs, whatever they may ultimately be, to go forward on a perfectly confident basis that we can meet such cost.

I would like to give you the figures to substantiate what I have said. We will have when we have received the com-

mitments from the Southern Company members a total of $3,908,000 of excess resources. We will have, on the basis of our financial schedules, as submitted in amendment to the application, at the end of the construction period free cash aside from working capital, of $1,520,000.

[3401]

In addition—

Q. I am sorry, I did not understand.

How did you identify that figure? A. I am reading from my notes but they can be substantiated by the financial schedules if you want to look at them now.

Q. I wanted to know how you identify that figure of $1.5 million. A. In the construction period financial schedule there is a figure showing the cash balance at the end of the construction period.

Mr. Morrisson: Are you referring to Exhibit XLIII.

The Witness: Exhibit XLIII, Schedule 1.

Mr. Claytor: It is Exhibit XLIII.

The Witness: I beg your pardon, Exhibit XLIII. Schedule 1 shows a cash balance at the end of construction period of $2,695,000. That includes of course $1,175,000 of working capital, which we consider is not available for excess construction cost because we are going to carry that all through the operating period.

The difference left from the working capital is $1,520,000.

Mr. Morrisson: Can I clarify something here?

You said you were referring to Exhibit XLIII. Are we to take it Exhibit XLIII is based on a revised construction

[3402]

schedule now supersedes Exhibit XXVIII, based on the original construction schedule?

Mr. Claytor: I am sorry.

Mr. Morrisson: I am confused as to which exhibit you are referring. XXVIII is based on the original construction schedule and XLIII on the revise?

Mr. Claytor: I don't think one can say that it supersedes it. I think they are made on two different assumptions. Exhibit XXVIII on what the testimony showed, is the existing construction schedule. Exhibit XLIII is on the tentative revised construction schedule which has not been formally adopted and we have computed the attached flow computation on both assumptions to show what the picture would be. The actual schedule might conceivably be something between them.

Mr. Morrisson: In any event, Mr. Acker is referring to Exhibit XLIII?

Mr. Claytor: Referring to Exhibit XLIII in giving that figure.

The Witness: Then in addition, the cost of the APDA facilities which will ultimately be turned over to the PRDC and incorporated in the reactor plant are included in the PRDC cost estimate at $4,131,700.

By Mr. Sigal

Q. Mr. Acker, if I may, we will get to the construction

[3403]

estimates later. A. This is developing a figure in response to your question, Mr. Sigal.

Q. All right, proceed. A. Now, PRDC has taken the value of these facilities into its structure on the receipt side at only $3 million, to put it on a conservative basis.

Q. That is not new? A. No, but I would like to say that the difference of $1,130,000 is an element of our cost estimate which we will not be required to meet. The difference between the cost at which it is included and the $3 million value which we will put on it, so that represents in addition a margin available for overrun of the construction estimate.

Now if you will add the $3,908,000, the $1,520,000 and the $1,131,700, you get a figure of available, unallocated resources of $6,559,700, which we consider, with the contingencies already provided for in our construction estimate an ample margin to take care of whatever overrun there may be on the actual versus the estimated cost.

Q. Now, this is including of course the $3,900,000 that you expect to get in 1961? A. That is right.

* * *

[3408]

Q. Well, you point out on page 2 of your supplemental testimony the additional contribution requested and you name the companies that have already made commitments. Do any of those commitments require approval by public utility commissions of the respective states? A. We are advised that they do not.

Q. None of them? A. That is right.

Q. Including Detroit Edison? A. That is right.

Q. Are you basing this on your own opinion or legal opinion? A. Legal opinion obtained from counsel.

* * *

[3432]

Q. Now, going to page 6 of your testimony, you state at the bottom of page 6 that in your computation regarding the income from the sales of plutonium, that you have based it for the period after June 30, 1962, on a price of thirty dollars per gram of plutonium sold to AEC.

Have you given consideration to the income you would derive if the price of plutonium were lower than thirty dollars per gram after that period? A. Yes, we have.

[3433]

Q. What have you done in that respect? A. We have calculated what our total plutonium revenue would be during the proposed ten-year operating period on the basis of twelve dollars for plutonium as the base price as of the middle of 1955, escalated in accordance with the provisions of the schedule to date and assuming the same annual escalation applicable in the future years.

Mr. Morrisson: Excuse me. The witness said as of the middle of 1955; is that correct?

The Witness: Yes.

Mr. Morrisson: Using the twelve dollar price in the middle of 1955?

The Witness: That is right.

Mr. Claytor: Escalated in accordance with Intervenor's Exhibit Y.

By Mr. Sigal:

Q. Do you have the document, Mr. Aeker? A. Yes.

Q. What do you have? You have a document making these calculations. May we see copies of it?

Mr. Claytor: Off the record.

The Presiding Officer: Off the record.

(Discussion off the record.)

By Mr. Sigal:

Q. Now, the paper you have referred to contains a

[3434]

figure showing plutonium revenues based on a plutonium price of twelve dollars per gram after June 30, 1962, on unescalated and escalated bases?

Mr. Morrisson: If there is going to be a discussion of this paper, I wonder if it would not help to have it marked for identification.

Mr. Sigal: Do you want this introduced as yours?

Mr. Claytor: I would suggest if we are going to have examination on this that we mark a paper consisting of a single sheet entitled "Plutonium Revenues based on Plutonium Price of Twelve Dollars per Gram after June 30, 1962, on unescalated and escalated bases."

I suggest we mark it for identification as Acker Exhibit No. 26.

The Presiding Officer: The document just described will be marked for identification as Acker Exhibit No. 26.

(Acker Exhibit No. 26 was marked for identification.)

By Mr. Sigal:

Q. Mr. Acker, I call your attention to the first column of this exhibit. This shows that at twelve dollars per gram your total receipts during the operating period 1962 to 1971 will be $14,139,000. A. That is right.

Q. And it also shows that this would be $18,611,000

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less than your present estimated revenue, assuming thirty dollars per gram unescalated price after June 30, 1963. A. That is right.

Q. What provision, if any, has PRDC made for the contingency that the price after June 30, 1963 will be twelve dollars per gram? A. We have made no provision as yet, Mr. Sigal. I think, however, we should say that that would be an extreme assumption because on the basis of the present schedule there is escalation provided so that it would be more realistic to use the second column showing a reduction of plutonium revenue of $10,328,000 as a measure of what additional provision we might have to make.

Q. Well, whether or not it is more reasonable or realistic to do so is not something that you are in any position to say at this time, are you, Mr. Acker? A. I think I am on the basis of my own judgment.

Q. That there is going to be this increase in price over the period of time involved? A. I think that is a fair assumption, yes.

Q. What is your assumption with regard to the increase in prices? A. 4.2 percent per year.

Q. Per year? A. Escalation applicable under the schedule.

[3436]

Q. Have you made any such calculation with respect to any other prices with which you deal? A. Yes.

by any of these contributing companies to make up any such difference? A. Certainly not. It would be foolish for anyone to undertake to do so until they know what the facts which they might have to deal with might be.

It may be entirely possible that this reactor might be modified to burn plutonium as a fuel, which would change the

[3439]

economics entirely.

Q. At the present time, your experts do not anticipate that during this ten-year operating period plutonium will be used as a fuel? A. No, I will not say that they do not.

Q. Pardon? A. I will not say that they do not anticipate it might be used for fuel.

Q. Would you say that they do anticipate it will be used for fuel? A. No, I will not say that, either.

But I say that is a matter that will have to be dealt with at the time.

Q. On page 8 of your supplemental testimony, you say that in projecting your operations over the ten-year period PRDC has assumed that the amortization payments will be met by the guarantor companies. A. That is right.

Q. It is clear, of course, that PRDC itself will not be able to repay its fifteen million dollar loan from its own income derived from operation? A. That is right.

Q. Now, you say you assume that the contributing companies will pay their guarantee. I gather from your written statement that the guarantor companies will meet these payments

[3440]

in a way that your loan agreement would have called for. A. We have the guarantee, Mr. Sigal.

Q. You have the guarantee from the contributors to the bank? A. That is right.

If PRDC cannot meet the payments, the member companies will guarantee the loans and are firmly committed to do it.

Q. But they are not going to do it by way of paying the money directly to the bank? A. I don't know at this moment.

Q. You don't know? A. I would think that as a practical matter they would put PRDC in funds to make payments to the bank.

Q. Is it your assumption, then, that PRDC will receive from each of these guarantors as part of this income enough money each quarter to pay the amount that falls due on your loan agreement? A. Absolutely.

Q. You are assuming that simply as a matter of good business? A. Mr. Sigal, if they did not do it, PRDC would be thrown into default and the whole principle of the loan is accelerated, the maturity of the loan is accelerated at the time of default, and these companies would have to make the full payment in any event under the guarantee.

[3441]

Q. What assurance is there, Mr. Acker, that these companies are not going to be willing to let all these payments be accelerated and pay off their loans to the banks? A. What is my assurance?

Q. Yes. A. It does not make any difference to me

whether they do, or not. If they want to pay it all off at once, so much the better. Then PRDC is free and clear of the loan.

But if it can be done on the basis of their spreading the payments out as provided for under the loan agreement, it seems to me it is perfectly all right for them to do that. The loan gets repaid under any circumstances.

Q. So far as you are concerned, it makes no difference how they do it, or whether there is default on the loans, or not, you consider that that is not a concern of PRDC? A. I think I have a firm commitment and we have made this statement merely to explain the basis on which this financial schedule was prepared.

Q. Now, on the same page, Mr. Acker, you say that your anticipated production costs have not changed since those calculated in Acker Exhibit No. 10; is that right? A. That is right.

Q. Now, are you saying, then, that despite the judgment of the trustees of PRDC and in spite of your anticipation that costs are going to rise on a steady trend, you,

[3442]

nevertheless, estimate your production cost without any change. Why is that? A. Without any change from the previous Exhibit C?

Q. Yes. A. I said before, Mr. Sigal, I would have to refresh my memory as to the extent at which escalation was provided in Exhibit 10 for various elements of production cost.

If it was provided, then it seems to me it would not be necessary to change the anticipated production cost in the new exhibit.

Q. Of course, you are not prepared to say that that is the case? A. I am not prepared to at the moment. I said I would have to refresh my memory on it by examining the financial schedules.

Q. Do you know whether or not there has been any reexamination of the production cost during the operating period since you last testified in this case? A. There has not been, to my knowledge.

Mr. Sigal: Just one moment, please.

Mr. Claytor: We were handing the witness Acker Exhibit 10 to which you were referring, Mr. Sigal.

The Witness: I can answer your former question, if you wish to have it answered now, Mr. Sigal, as to what provision is made in the escalation of the production cost.

[3443]

By Mr. Sigal:

Q. All right, you may answer. A. I am quoting from Exhibit 10, under production cost, under operation, labor, the labor costs are escalated at four percent compounded annually.

The material costs, we provide no escalation.

As to maintenance, under labor, again the labor costs are escalated four percent compounded annually.

As to material and maintenance, there is no escalation provided. There is no escalation provided as to general administrative overhead, as to auxiliary services.

There would be escalation to the extent that the contracts for these services provided.

As to auxiliary power, there is no provision for escalation.

Q. So far as Exhibit X shows, the only escalation provided is that with respect to labor costs? A. So far as the cost estimates in Exhibit X are concerned, that is right.

Q. I am talking about production cost. A. Yes.

Q. So the material costs are general administrative overhead, auxiliary services, and so on. None of those provide for escalation? A. That is right.

[3444]

Q. And the same is true for the processing costs? You provide for no escalation in your processing costs? A. That is right.

Q. So that overall, the escalation provided, as far as your operating cost is concerned, is a minor fraction of the total, is it not? A. It depends on what you mean by minor fraction. I have not calculated it. I don't know.

Q. In any event, it is clear from Acker Exhibit 10 what items provide escalation and what do not.

Now, under the circumstances, Mr. Acker, since you have refreshed your recollection with respect to the production cost and with respect to the matter of escalation, in your opinion, does the estimate of operating costs that do not cover escalation, or substantial ranges of those costs, constitute a reasonable basis for estimating your costs for that period? A. I believe so.

Q. So that by the same terms, it would be just as reasonable not to consider escalation of plutonium prices? A. I don't think that, Mr. Sigal. It depends on the basis of your original estimate. If you are making labor cost estimates, it is customary to escalate them.

You have some basis of determining what a reasonable, fair percentage escalation might be.

But if you make your original estimate of the cost of

[3445]

materials annually liberal to begin with, there is no reason for escalating it.

When you come to the question of plutonium revenue, where your revenue is a very material part of your total financial structure, I think it is entirely reasonable to escalate them.

By the same token, I feel it is entirely reasonable to escalate your steam reserve.

Q. So you feel that the matter of escalation or items for escalation should be included only in those situations where you have made a pretty tight estimate of cost initially? A. Made too tight, I don't think that characterizes what I have said properly, Mr. Sigal.

What I am saying is that you have two choices when you are going to estimate further cost. As to labor, you start with the present-day labor rates and escalate them. That does not mean you made too tight an estimate of your original cost. You have taken from what you know to begin with and escalated it.

Now, against that, the other type of estimating is to make a liberal provision for an item and carry it through your future period and based on your judgment that that will amply provide for it.

It is a question of an exact formula against a judgment figure.

[3446]

Q. So you can provide an exact formula only with re-

spect to labor and you cannot provide an exact formula with respect to material and other costs? A. I think it is less reasonable to provide an exact escalation basis for the whole heterogenous mass of different material.

Q. So that you feel that you can now, for example, provide an exact labor cost in 1962? A. Mr. Sigal, I have never said that.

Q. You provide for escalation in 1962 based on labor cost? A. I have never said that was an exact estimate. I have said that that was the basis for our estimate which we think is a reasonable basis, but I have not stated it resulted in an exact labor cost in 1962.

Q. I am only trying to get an explanation from you as to why with respect to certain costs you provided escalation and with respect to other costs you do not provide for escalation.

My understanding was that where you were able to provide a more or less precise estimate of current costs, you also provided for escalation. And where you are not able to provide a more or less precise estimate, you were liberal and, therefore, did not need an escalation factor; is that right? A. Yes.

[3447]

Q. So I, therefore, ask you, Mr. Acker, can you now, inasmuch as you have provided for an escalation factor on labor beginning in 1962, say that the labor figure for 1962 is more or less precise? A. It is precise as a result of the application of an escalation percentage, Mr. Sigal; it is only as good as your judgment is as to what that escalation figure should be for the period.

That is the nature of an estimate.

Q. Now, Mr. Acker, on page 10 of your supplemental testimony, you state on the basis of the statement received from Commonwealth Associates, that a stretchout of construction schedule of six to eight months is likely.

Now, can you tell us what has made that eight-month stretchout necessary? A. Delay in the fabrication of some of the important elements ultimately going into the reactor structure.

Q. Do you know what elements have been delayed? A. Particularly the reactor vessel.

Q. Is that in itself the delay factor which delayed you for eight months? A. I would say that is the largest single factor, yes.

Q. Now, that reactor vessel is to be installed in 1958, is it not? A. That is right.

[3448]

Q. When was it supposed to have been installed? A. Under the present schedule, prior to this examination referred to which Commonwealth Associates have made, the reactor vessel was due for delivery in January of 1958.

Q. When is it due now? A. Now wait, let me go back, Mr. Sigal. It was due for delivery this year on the basis of the present schedule.

On the basis of the stretched out schedule, it is due for delivery in the early part of 1958. That is the particular reason for the stretchout.

Q. Now, I call your attention to Exhibit XLII, a letter from Commonwealth Associates. A. Yes.

Q. You will note there in the second paragraph that they

say the reactor vessel is going to be delivered to the job by January 15, 1958. A. That is right.

Q. Now, that is certainly not six or eight months after the time it was previously scheduled for delivery, is it? A. Yes.

Q. When was it supposed to be delivered before? A. I think in August of this year.

Q. No matter how you figure it, Mr. Acker, that is obviously not eight months. A. We talked about a stretch-out of six to eight months.

[3449]

For the purpose of this exhibit, we have used the eight-month figure.

Q. Is there any other delay? A. I think that is the principal one, Mr. Sigal.

Q. Now, you will note that Commonwealth Associates are not at all certain that there will not be other delays or even a stretchout of more than eight months? A. I don't think anybody could be, Mr. Sigal.

Q. They say in this letter, Mr. Acker, that they have not completed their revised construction schedule in detail? A. That is right.

Q. So that there may well be additional delays? A. Well, I think they conservatively gave us the figure of six to eight months and that they believe that when they have made definitive new schedules on an item to item basis, that it will fall within the eight-month period.

Q. Do you know why the reactor was delayed for six months or whatever it was? A. I suppose for the same reason that any other reactor vessel has been delayed from time to time as against a construction schedule. This is

an evolution process of fabricating these completely new components.

There are changes in design that occurred during the construction and fabricating period. There is a tremendous

[3450]

amount of research, metallurgy that has to be resolved, and there are many factors that are so completely different from anything that the manufacturers have ever been up against before that I would bet my bottom dollar that you will not find a reactor vessel that has been delivered on the original promised date.

Q. When was the contract for the reactor vessel let, Mr. Acker? A. I don't remember the date, Mr. Sigal. But my recollection is that we had fully expected the reactor vessel first to be delivered last October.

Mr. Claytor: Mr. Sigal, I believe from our records it is indicated that the order was first placed in the fall of 1955.

Mr. Morrisson: That is at page 2526 of the transcript. I looked it up this morning.

By Mr. Sigal:

Q. Was it actually let in 1955, Mr. Acker? A. I believe so, Mr. Sigal.

Q. At the time you testified in this case, was it not referred to as a proposal?

[3451]

A. I would not without refreshing my mind as to my testimony, I would not recall what terminology I used.

I would not want to say without refreshing my mind on my written testimony or written transcript as to how I did characterize this. But it is a fact that we had a proposal against which an order had been placed.

Q. I simply call your attention to Acker Exhibit 7, item C, reactor plant equipment, in which the reactor vessel is referred to as a proposal to APDA. A. Yes.

Q. This was in March 1957.

Mr. Claytor: And Acker Exhibit 20 states this as one of the items on order by APDA.

By Mr. Sigal:

Q. So that apparently was put on order some time around March of 1957? A. I think it was put on order long before that, Mr. Sigal.

Q. In any event, Mr. Acker, it does appear again from your own testimony that the difficulties involved in the manufacture of this item have necessitated an increase in the anticipated period of manufacture of something in the neighborhood of 50 per cent. A. Yes.

Q. Or more perhaps?

[3452]

A. Maybe.

Q. Do you have any assurance that other complicated items involved in this reactor will not be delayed 50 per cent or longer in the time required for manufacture? A. I don't have any assurance any more than you have anything else in life, Mr. Sigal. That is a possibility. We do not foresee any such similar delay would affect any other element.

Q. As a matter of fact, in March of 1957 when you tes-

tified, you saw no reason for a delay in the manufacture of this vessel by six or eight months, did you? A. That is right.

Q. But you say now no other item is likely to be delayed so far as its manufacture? A. I say now I know of no other item as to which we could expect that kind of delay.

Q. Why will the delay in the manufacture and installation of the reactor vessel cause an 8-month delay in the entire project in as much as many other items are on manufacture simultaneously with the reactor vessel? A. It would be because it is such an important component of the whole structure that to the extent that it is delayed the completion of the whole plant is delayed similarly.

Q. But the manufacture of the plant itself,

[3453]

Mr. Acker, is to be completed long before 1961. When you talk about the plant structure aside from the reactor? A. Well, I am not saying that there are many other elements of the plant will not have been completed before that time. Let me give you an example of what I am talking about. If we are building a steam station and the delivery of the turbine is delayed for eight months, why, the completion of the plant is delayed for eight months. This is in the nature of that kind of equipment.

Q. Is it in the same nature, Mr. Acker? The entire plant aside from the reactor components themselves is to be completed in 1958, is it not? A. Under this stretch-out it is indicated the plant may not be completed until September 1, 1960.

Q. That is just my point, Mr. Acker. Why will a delay in the manufacture of the reactor vessel delay the entire project in as much as most of these other items proceed simultaneously as far as their manufacture is concerned?

Mr. Claytor: Mr. Examiner, he has answered the question twice.

Mr. Sigal: He has given a conclusion, Mr. Examiner. He has not explained why the delay is caused.

The Witness: I have given you my best explanation

[3454]

as to the reason for the delay of the reactor vessel. I say the plant can not be completed until the reactor vessel is installed and if there is an 8-month delay in the delivery of it as against the original final completion date for the whole plant, I think it is entirely reasonable to assume that there will be the same delay in the completion of the whole plant.

By Mr. Sigal:

Q. Is it reasonable to assume that? Why could not all the components be ready for installation when the reactor vessel itself was installed? A. Mr. Sigal, we will use our very best efforts to get this plant in operation just as rapidly as we can, I can assure you that.

Q. I welcome your assurance, Mr. Acker. What we want here is facts. I want to know whether or not you know why the delay of the installation of the reactor vessel to January 15, 1958, requires a delay until August 1961 in the completion of the reactor.

Mr. Claytor: Mr. Examiner, he has already explained how it works. It is exactly like a steam turbine in another plant. I feel that the explanation in answer to that question is already on the record and it is adequate. I think asking it over and over again comes under the heading of harassing the witness.

[3455]

Mr. Sigal: We are not talking of steam turbines. That is the first I have heard that there is any relation between steam turbines and reactor plants.

The Presiding Officer: Well, the witness was drawing the analogy in comparison with a steam turbine. I understood what he was driving at in answer to your question. I think you are asking the question over again.

Mr. Sigal: But he has not given any answer.

The Presiding Officer: He has given you what is his best judgment as to the reasons for the delay.

Mr. Sigal: The point I am trying to arrive at, Mr. Examiner, is whether or not Mr. Acker is qualified to have a judgment on the matter.

Now Mr. Acker is not a builder. Mr. Acker has never witnessed the building of a reactor plant.

The facts here show that the reactor vessel will be installed, they expect, around January 15, 1958. Their evidence here indicates that they will complete construction of the entire plant by August 31, 1961.

I am asking why the delay of the several months in the manufacture of the vessel requires a stretch-

out of the entire project, so late after the installation of the reactor vessel. Mr. Acker simply says that is how it is. If that is an answer, if that is the best that Mr. Acker can do, then perhaps we will have to have somebody who is qualified to

[3456]

answer the question. But certainly Mr. Acker has not answered the question.

The Presiding Officer: Mr. Sigal, I think you have made your point and I think Mr. Acker has given his answer and as to what his judgment is or is not I am afraid will be up to the Commission to determine and not the examiner.

Mr. Sigal: The point I am making, Mr. Examiner, is the point I started out with this morning. We are not given the opportunity of cross examination here because Mr. Acker does not know and we have not had a word that anybody else will be put on the stand who does know. The man who wrote this letter, Commonwealth Associates, all those responsible for the actual building of this reactor, have never shown up in this hearing. We have never been able to examine anybody who is actually responsible for the building of this reactor.

The Presiding Officer: Mr. Sigal, whatever weight is to be given to the testimony of Mr. Acker is for the determination of the Commission. I do not think we ought to pursue the point any further.

By Mr. Sigal:

Q. Mr. Acker at the bottom of the page of Exhibit XLII this sentence appears, the last sentence on the page:

"In addition we assume that overhead and administrative costs which we have never included in our construction

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estimate and which we understand has been estimated by your staff at $1,816,000 to December 31, 1960 would also have to be increased to cover the additional time allocated to construction and testing."

Can you explain that sentence, please? A. If you have a longer construction period, what they are saying is that you will have a longer period of administrative expense. And responsive to that factor in estimating the new cost, over-all cost, we now estimate that for the original period plus the stretch-out period the administrative expense would increase to $2,170,000.

Q. I am sorry, you lost me. $2 million what? A. I am saying instead of $1,816,000 of administrative expense during the construction and test period for the longer construction period, the administrative expense would be $2,170,000.

Q. Now, are you including the increase in the cost of your financing as part of your administrative expense? A. No.

Q. Where did you get this figure of $2 million plus?

Mr. Claytor: Mr. Sigal, it is on schedule No. 2 of Exhibit XLIII.

By Mr. Sigal:

Q. Which figure are you referring to, Mr. Acker? A. The figure on schedule 2 of Exhibit XLIII. I am

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referring to the item, next to the last item on the page,

"administrative expense" totalling for the new stretched-out construction period $2,170,000.

Q. Is that a correction of this figure of $1,816,000? A. Is that a what?

Q. Correction.

I want to know where this figure of $1,816,000 came from. Has it ever appeared before? A. Certainly. It has been evidenced in this proceeding right from the start.

Q. I ask you where does it appear.

Mr. Claytor: Exhibit XXVIII. It also appears in Mr. Acker's original narrative testimony at page 15.

By Mr. Sigal:

Q. This figure of $1,816,000 is referred to by Mr. Moulton as a figure which has never been included in your construction estimate.

Now, is Mr. Moulton wrong? A. No, Mr. Moulton made merely the construction estimate but he did not in his figures include the administrative expense during the construction period. We added those as a result of our own estimate. He is merely saying that he has not been responsible for estimating that element of the construction cost in the past.

Q. What I have tried to inquire into, Mr. Acker, is the

[3459]

meaning of this sentence in this letter.

Now, if this has always been included as a part of your estimated expense and cost, whether you did the construction or otherwise, Mr. Moulton apparently found it necessary to make a specific reference to the fact that it has not been included in the construction estimate.

I am asking why he did that. A. I simply think he did it to clarify what his estimates covered, the estimated plant cost. To do that he is calling attention that he hasn't in the past included this administrative expense item but that we should take this into account and make such change as is necessary to reflect the higher cost in the longer construction period.

Q. Now, you will notice the very last phrase in that sentence that the additional time is allocated to construction and testing. A. Yes.

Q. It appears that Mr. Moulton did not consider the stretch-out to be caused entirely by additional construction time required. Isn't that what appears from this statement? A. Not to me, Mr. Sigal.

Q. Does not Mr. Moulton say that additional time is allocated to construction and testing? A. Yes, so far as the administrative expense is concerned.

[3460]

Q. I am not now talking about administrative expense. Mr. Moulton says that this figure would have to be increased to cover the additional time allocated to construction and testing. A. Yes, but I think he is talking about time allocated to construction and testing related to the administrative and overhead cost. You have to read the whole sentence, Mr. Sigal, to get the sense of it.

Q. But Mr. Moulton is saying that additional time is required for construction and testing, is he not? A. I don't think that is what he is saying at all. It seems to me if you read the whole sentence it is amply clear. He is talking about the overhead and administrative costs which

must be increased because of the additional time allocated to construction and testing.

Q. That is what I said, the additional time being allocated to construction and testing. So that the additional allocation of time is not merely for the purpose of construction but it also includes more time for testing. A. No, that is not the fact and our schedule I think makes that entirely clear. We have provided the same one year for a pre-operational test that we have provided in the past.

Q. As of what time do you expect the reactor to be completed under the new schedule?

[3461]

A. September 1, 1961.

Q. Is that within the time for which you now have a permit?

Mr. Claytor: I think the witness misunderstood your question or the witness and the question are not in agreement on what is meant by completion.

Do you mean the completion of the construction alone or do you mean the completion of construction and test period?

Mr. Sigal: I mean the completion of the reactor.

By Mr. Sigal:

Q. Will you look at Exhibit XLIII, Schedule No. 1, Mr. Acker. You will note the next to the last column of that exhibit. Do you have it before you? A. Which one?

Q. Exhibit XLIII, Schedule No. 1. A. Exhibit XLIII, yes.

Q. Now this schedule is titled "Preliminary Revised Construction Schedule." That shows that this revised con-

struction schedule provides for the end of construction on August 31, 1961, does it not? A. No. I am sorry if I misled you on that, but if you will look at the text which is the first page of that exhibit, you will see that statement is made that this schedule shows the source and application of cash during

[3462]

the construction period.

Further, this construction period includes the year 1956 and extends through the pre-operational testing ending August 31, 1961."

In other words, this is the date, August 31, 1961 is the beginning of the 10-year operating period. So that the construction of the plant, aside from the pre-operational testing, would have been September 1, 1960.

Q. That is what is stated, of course, in the letter of Commonwealth Associates in Exhibit XLII. A. Yes. I thought you were asking me that question.

Q. Yes, but this exhibit itself states a revised construction schedule showing the construction period as ending August 31, 1961. A. Not if you read the text as well, Mr. Sigal.

Q. When does the pre-operational testing period begin? A. September 1, 1960.

Q. Does that appear here? A. It does if you will read that first paragraph of the text, stating the assumptions under which the exhibit was prepared.

Q. The first paragraph of the text, you say, of Exhibit XLIII? A. That is right.

Q. That shows that the pre-operational testing will

[3463]

begin on September 1, 1960. A. It states that it will end August 31, 1961, one year.

Q. It says "This construction period includes the year 1956 and extends through the pre-operational testing ending August 31, 1961."

Now that does not say that pre-operational testing begins on September 1, 1960? A. Mr. Sigal, I assume you remember that all through this testimony, certainly all through my testimony we have always talked about one year of pre-operational testing.

Q. I know what you are talking about, Mr. Acker. I am trying to find out what these documents mean that have been introduced in evidence. You talked about a good many things in March 1957 which have been changed since March 1957.

Now, I do not see in this material that has bee introduced today that in anything except possibly the letter in Exhibit XLII that your pre-operational testing will begin September 1, 1960.

Mr. Claytor: I thought that was Mr. Acker's testimony about three times and it certainly is now in the record. If there is any doubt about it it has been dispelled in the last ten minutes.

The Presiding Officer: I thought the witness

[3464]

explained that, Mr. Sigal.

Shall we be in recess for about five minutes?

(Brief recess.)

The Presiding Officer: The hearing will be in order.

By Mr. Sigal:

Q. Mr. Acker, you say on page 10 of your supplemental testimony that PRDC is not yet able to adopt a new definitive construction schedule. The question of schedule revision is still under study by Commonwealth Associates.

What is the reason for this delay in arriving at the definitive construction schedule? A. Because of the study which Commonwealth Associates is currently making of each individual item of the construction schedule. That has not been concluded as yet.

Q. Construction of the reactor started a year ago? A. Yes.

Q. And construction has been going on throughout the year, is that right?

Q. Despite that fact, the construction schedule is not yet definite? A. That is right.

Q. Now what is there in the nature of the details of the problems of construction which has prevented Commonwealth Associates and PRDC from arriving at a definitive construction schedule?

[3465]

A. Some of the design work has not been completed. There are items as to which additional research work is required.

Q. What design work has not been completed? A. Do you want me to try to give you specific items? One that comes to my mind is—

Q. Well, are you in a position to testify— A. If you

will let me answer, I will say that one that comes to my mind as an example is the Cask car. That is under study at the moment by Dr. Zinn's organization. And the study has not yet been completed.

The design has not been made of it. So that we have nothing definitive on which to ask for bids. That situation has to be reappraised to fit into the construction schedule. There are additional items of that kind.

Q. What additional items do you know about? A. The fabrication of the fuel elements. Those are the ones that come to my mind immediately.

Q. Who would have more detail on the problems? A. Mr. McCarthy would.

Q. He would know which items have not yet been designed or the designs have not been completed? A. He would be more qualified to testify along those lines than I am.

Q. In addition to design problems, what other problems

[3466]

are there that have delayed the schedule? A. I think it would be principally design.

Q. I understand, but what other problems are there besides design? A. That cause the delay?

Q. Yes, that make it impracticable to determine a specific construction schedule. A. I have not said it was impractical to determine a specific construction schedule.

Q. Or which has delayed the determination of a schedule? A. I don't know of any other items, Mr. Sigal. As I said, I think the delay would be principally because of the design problem.

Mr. Claytor: Excuse me. I think Mr. Acker is speaking of the delay in the construction.

I think that Mr. Sigal's question, if I understood it correctly, which was a little difficult to understand, is why we do not yet have a new revised definitive construction schedule. That is a delay in the creation of the schedule as distinguished from the delay in the construction. Is that right?

Mr. Sigal: Yes.

The Witness: I thought I answered that previously, Mr. Sigal. I thought I said that was under way at the moment.

[3467]

Whatever time it takes to revise the construction schedule based on the study of each individual item still to be fabricated, ordered, and so forth, whatever that delay is it is. Whatever time is required we have to stand for it.

By Mr. Sigal:

Q. Then so far as the schedule that is now indicated that also is a tentative matter? A. I stated that previously, yes.

Q. And there is no assurance in so far as PRDC itself is concerned that the construction of the reactor will be completed by September 1, 1960, is there? A. Nobody can ever have such assurance, Mr. Sigal.

Q. Of course, if the construction is delayed beyond what you now indicate, of course your construction costs will be increased beyond those that you now estimate. Is that not true? A. I think it is entirely possible that

some element of your construction cost would be increased. Certainly your administrative cost during construction would be.

Again I would like to point out that we feel confident that the $6,000,000 that we have available would cover such a delay as well as unforeseen increases in cost.

Q. Now I call your attention to Exhibit No. XLV. A. I have it, Mr. Sigal.

Q. Now this exhibit is entitled "Comparison of the

[3468]

Construction Estimates and Commitments." And it shows the comparison of the major items involved in the construction of the reactor and concludes with a showing that the overrun at the present time comes to 7.4 per cent. A. That is right

Q. However, if you would examine the individual items, Mr. Acker, the over-run on the large items particularly is far greater than 7.4 per cent. A. That is true.

Q. For example; I call your attention to the liquid metals, item D-3, intermediate heat exchanger, the over-run there is 183 per cent.

In the case of two loops, primary sodium piping, the over-run is 147 per cent.

In the case of the secondary containment, the primary sodium system, over-run is 300 per cent.

Mr. Morrisson: Is that an over-run of 183 per cent?

Mr. Claytor: It is 183 per cent of the original cost estimate.

Mr. Sigal: I don't think we need comments from everybody around the table, Mr. Examiner. I am

only reading what this says. If the witness wishes to correct what appears on the exhibit, he can correct it.

Mr. Morrisson: I just wanted to have it correct in the record.

[3469]

The Witness: I will state that your statement is incorrect as read from the exhibit. The 183 figure that you see, if you look at the top of the column, it is percentage of the estimated cost represented by the Order or commitment, so that that would be an over-run of 83 per cent.

By Mr. Sigal:

Q. The statement there is 183 per cent of the original cost? A. That is right.

Q. And the two loops of primary sodium piping shows 147 per cent of the original cost.

The secondary containment of the primary sodium system shows 300 per cent of the original cost.

Now, the liquid metals system shown on this schedule is far and away the largest item on the schedule, is it not, intermediate heat exchanger. A. That individual item is the largest on the schedule, yes.

Q. Now it appears, does it not, from this schedule that the over-run is found primarily in the reactor items themselves rather than in the, shall we say normal construction cost? A. That is true.

Q. So far you have had experience with these costs, so far as in construction, improvement, excavation and so forth,

[3470]

your estimates were fairly sound. A. Yes.

Q. As to the item with respect to the reactor, it appears that your estimates were quite low compared to what the costs turned out to be. A. On the basis of these individual items, that is correct.

Q. Under the circumstances, to say that your overrun is only 7.4 per cent is stating an average which does not reveal the significant problem of estimating the costs of the unique structures involved in this reactor, isn't that right? A. I agree fully that it is an average and the nature of an average is that it does not reveal the individual items which make it up.

Q. It would also appear, would it not, that as time goes on and you get into the manufacture of the items which are of this unique variety, namely, the special components of the reactor, it would appear that your estimates are likely to understate the cost in the same order as you understated them with reference to the liquid metals system? A. No, I don't agree with that, Mr. Sigal.

Q. Why don't you agree with that? A. Just because that has happened with respect to individual items here does not mean that it will obtain

[3471]

throughout the balance of the construction schedule.

Q. But the point I thought you agreed with me on was that when you were getting to the manufacture of the unique items as I call them, your estimates have proved to be quite unreliable. A. As to those that are presented here, that is true.

Q. What reason is there to expect that your estimates will prove more reliable with regard to the same type of component parts that you have not yet come to? A. Because there is no reason to expect otherwise. It seems to me it is entirely open-ended, Mr. Sigal. I can not say as to whether all the balance of the items in this category would be equally under-estimated.

Q. I did not say that you can say, Mr. Acker. I am suggesting that you are also in no position to say that they will not be under-estimated to the same extent. A. I will agree with that. But I think it would be unreasonable for me to make either statement, Mr. Sigal. They will be what they are and again I would like to urge that we feel that we have adequate resources to cover them, whatever that may be.

Q. Of course you will recall, Mr. Acker, that when you testified several months ago that you were quite confident that the estimates that you reported then were sound. You remember that?

[3472]

A. Yes, I do.

Q. You had no reason at that time to believe that the costs would be substantially greater than you estimated them at that time to be.

Now you do have experience and your experience shows that with respect to these more complicated items, items in which manufacturing experience is extremely limited, your estimates have proved to be quite unsound? A. As to these particular items, that is true.

[3473]

Q. Now, are you in any position to give any estimate—perhaps you have already answered this question before—are you in any position to report any estimate with respect to the extent to which your construction costs will exceed your previous estimates? A. No, I am not, Mr. Sigal; at this time.

Q. Is anybody in the PRDC organization prepared to do that? A. I don't think anybody is, Mr. Sigal. I will say again that it is our best judgment that the overrun will be under the resources that we have available to meet them.

Q. Now, on page 12 of your supplemental testimony you say, "No substantial additional material to be incorporated in the reactor has been placed on order by APDA since the preparation of Acker Exhibit No. 20."

When was that exhibit prepared, Mr. Acker? A. Where is that statement, Mr. Sigal?

Q. On page 12.

Mr. Claytor: Acker Exhibit 20, I believe the record will show, was prepared at the time of Mr. Acker's cross examination which I believe was in March. The record will show.

Mr. Sigal: The exhibit itself does not show. It was some time in March that this exhibit was prepared.

By Mr. Sigal:

Q. Your testimony then indicates that between March

[3474]

1957 and August 1957 no substantial additional material has been placed on order.

It seems to me to be a long time during the construction period not to have placed on order materials necessary for the construction of this reactor, Mr. Acker. Can you explain the reason for that? A. This applies to APDA, this statement, Mr. Sigal; not to PRDC.

Q. That is right. A. The fact is that APDA have covered the bulk or a substantial part of the test facility at that time.

Q. You say they have already placed on order the substantial bulk of it. Is that the reason they have not placed on order any more? A. I say that at that time they had placed a substantial amount of the orders for the test components, and no additional orders have been placed since then.

Q. That is what you say, but there is a substantial amount yet to be placed on order by APDA? A. That is right.

Q. Now, I ask you why, if you can tell us, APDA has not, during this intervening period of at least four months, placed anything more on order? A. Because they have not been ready to, Mr. Sigal.

Q. Obviously they have not done it. Do you know why

[3475]

they are not ready to do so? A. Because they still have some design and research work to do before the additional orders for materials are placed.

Q. Do you know on what items they are still doing design work which they are supposed to put on order? A. It would not necessarily be design. It could be design or investigation, but the orders have not been placed

as yet for the core. I think that orders have now been or are about to be placed on sodium pumps. That was another item that took long investigation and negotiation. I think those would be the principal items that have been delayed.

Q. Then your testimony is that the reason that APDA has not placed any orders in any substantial quantity since March is that the design has not yet been completed on those items? A. Or their investigation of a particular item has not been completed.

Q. So they have not gotten to the design stage, you mean, on some items? A. I do not mean that. I do not mean that no design work has been done on some of it.

Q. Isn't that what you mean by the investigation is going on? A. It could be an investigation on what manufacturer

[3476]

could fabricate the equipment.

Q. Now, at the bottom of page 12 of your supplemental testimony you say that you think that your estimates are more realistic than much of Mr. Radley's testimony seems to indicate. Is it your position, Mr. Acker, that Mr. Radley's estimates are not realistic? A. In some respects, yes.

Q. In what respects? A. To begin with, Mr. Sigal, in comparing estimates for large construction projects of this type, it seems to me that you must be sure that your basis is correct to begin with. I think that Mr. Radley's concept of a power reactor construction estimate was that of one organization undertaking to do the job begin-

ning from the beginning and carrying it through its construction period.

I would like to point out that in the PRDC case that is not the fact. APDA had done a great deal of work prior to the PRDC coming into the field, and in addition, APDA is carrying on extensive work for PRDC's account without charge, which would normally appear in a construction estimate where it was all being prepared and undertaken by one organization.

So I think that the basis for the comparison of our estimate with that of some other reactor project now being undertaken in the same way is invalid.

[3477]

For example, take the item I have spoken of, indirect and overhead expense. I think in addition, on an item of that kind, you would have to understand the character of the contract under which that kind of work is being undertaken. You will remember that our contract with the United Engineers and Constructors which this item of $2,977,000 covers is on a non-profit cost reimbursable basis.

Mr. Radley has given estimates as to what the indirect and overhead expense would be on a project, I take it, that he was assuming that one organization did the whole job on a conventional basis, I would assume, with profit involved to the contractor who was doing the construction and erection.

In our case we estimate that saving to PRDC under our United Engineers contract as a result of it being on a non-profit basis—

Q. Who is on a non-profit basis? A. United Engineers and Contractors.

Q. They are doing this for you without any profit? A. On a non-profit basis, cost reimbursable basis. We assume that if it were on the conventional basis, that we were hiring men to build a steam plant for a utility company, that the estimated cost would increase $500,000 at least.

So that to get a comparable figure in our case for the usual concept of indirect and overhead expense, I think you would have to add that figure, at least.

[3478]

Now, in addition, APDA has undertaken to do research and other work for us during the construction period and their administrative expense during PRDC's construction period is estimated at $2,250,000.

Q. What is that for, you say? A. That is the administrative expense of APDA during PRDC's construction period.

Q. $2 million? A. Right.

Q. For administrative expense alone? A. For administrative expense during the PRDC construction period.

Q. You mean out of a total contribution of $7 million— A. This is in addition to their $7 million. This is an expenditure on their part for administration and overhead during our construction period beyond their commitment to us which we have valued as $7 million.

Q. How do you arrive at that figure? A. I get it from their budget for the next three years. That is in evidence in this proceeding.

Q. Is there anything in evidence in this proceeding showing that? A. There is; yes, sir.

Q. Will you point out what you refer to?

Mr. Claytor: This is derived from Acker Exhibit 4.

[3479]

By Mr. Sigal:

Q. Acker Exhibit 4 shows a total of $2,257,979 for the period beginning 1/54. A. That is right.

Q. Construction in this case started late in 1956, did it not? A. Yes, but it depends on what you call your construction period, Mr. Sigal. This character of project there is a great deal of work that has to be done before you actually begin to dig a hole in the ground.

I think it is reasonable to assume that that is the first part of your total administrative and overhead expense on the project.

Q. Of course, Mr. Acker, you testified earlier that APDA is doing things other than working for PRDC and the administrative expense indicated here is the total administrative expense, is it not? A. That is right.

Q. There is no allocation in this thing to which you refer of the administrative expenses relating to the PRDC project? A. That is right. I gave you the approximate figure. The proportion of the total cost, total expense budget, to the amount which is allocated to other items and those for the benefit of PRDC is very small.

[3480]

Q. Of course, you make that statement, Mr. Acker, but you have not presented, so far as I am aware, any break-

down showing what the expenses are with relation to each of the projects handled by APDA.

Now, Mr. Acker, you, I assume, read the testimony that Mr. Radley gave? A. Yes.

Q. You are aware that Mr. Radley made his estimates on the basis of his experience of many years in the building of reactors? A. Yes.

Mr. Morrisson: Mr. Examiner, I would like to correct the record on one point.

There have been several references to Mr. Radley's estimates. I think his testimony was very clear that he was not making estimates; that he was making certain comments on the estimates furnished by the applicant, but he did not feel in a position himself to make any estimate of the cost of construction of this reactor.

Mr. Sigal: I did not say he made any estimates about the reactor cost. He did make estimates about the cost of certain items.

Mr. Morrisson: The record will show what it shows. I don't think he did.

Mr. Sigal: All right. Your comment is well taken.

[3481]

the record will show.

By Mr. Sigal:

Q. Now, Mr. Acker, your own testimony, as shown in this supplemental statement, goes into some items, but does not refer to a number of other items that Mr. Radley did mention.

For example, he stated in his testimony that PRDC substantially under-estimated the cost of on-site labor. Now, you have made no reference to that. Are you in any position to state wherein Mr. Radley's testimony was in error? A. I can point out certain areas which I think he had no knowledge of, so that would necessarily be taken into account when he stated that a more usual relationship between total cost and on-site labor would be 6 to 4 as against our 18 to 5.

To begin with, there are items totaling $3,742,650 that were estimated on an installed basis, an overall basis for each item. For instance, a building might be estimated at so much per cubic foot with no breakdown specifically, no definitive estimate as to labor and material relationship.

In those cases, there are all of these items totaling that amount where in order to arrive at a labor-material division in the estimate, we simply made an arbitrary division of labor and material. That may be in error, so that that can be a reason for a part of the difference, if the comment is

[3482]

valid.

In addition, there is some $887,000 of items that were estimated on an installed overall cost basis with no breakdown of labor and material and, therefore, the whole item shown under the material column. Now, as to those things, I don't know the extent to which they would influence Mr. Radley's thinking if he knew them or would modify our material-labor relationship or ratio which he commented on.

I merely want to point out that they are two reasons that our ratio might not be comparable to somebody else's ratio.

Q. As events turned out, Mr. Acker, it appears that you did seriously under-estimate certain of your costs with reference to your on-site labor. For example, referring to Exhibit XLV, with respect to structures and improvements, there was an overrun of 13 percent on your dredge and grade fill. There was an entire item for which you did not make any provision at all with respect to dewatering the excavation, which is probably substantially on-site labor.

These two items alone, on the basis of your own figures, total $64,000 out of a total for structures and improvements and reactor plant structures of less than $300,000. A. Mr. Sigal, in the first place, I think it is entirely invalid to assume that the overrun on the dredge and grade fill item is because of on-site labor. I think it can

[3483]

perfectly well be the difference in the quantity of the fill involved.

Q. My statement was made with reference to the dewatering excavation as being largely on-site labor. A. You called my attention to the dredging and grade fills and said that was a 13 percent overrun and implied it was because of an overrun on on-site labor.

Q. I am not arguing with what you have said, Mr. Acker. The point is that you have $64,000 which you will agree, would you not, that a substantial part is on-site labor? A. I will not agree that a substantial part

of the overrun is necessarily on-site labor. It may be quantities of materials involved.

Q. Do you know, as a matter of fact, what this $64,000 item for dewatering excavation consists of? A. That is an item, Mr. Sigal, that was not specifically set forth in the estimate, but was included originally in the provision for excavation, grouting foundations, and so forth, and I think that that, depending on how you make your estimating, is an entirely proper procedure.

We have set it forth because when we ran into the foundation condition, we found that there was some water that had to be continuously pumped and it became a very considerable item, more of an item than such incidental pumping would be in normal foundation work.

[3484]

Q. My question to you was— A. The greater part of this is not labor. It is continuous pumping of the water and the provision for the installation of such pumping equipment.

Q. Can you answer the question how much of that $64,000 is labor? A. No, I cannot and I think it is unreasonable to ask me to.

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[3486]

The Presiding Officer: The hearing will be in order.

Mr. Sigal, I understand that Mr. Acker wants to make a correction to some of his testimony yesterday.

Whereupon

ERNEST R. ACKER, the witness on the stand at the time of the taking of the recess, resumed the stand and, having been previously duly sworn, was further examined and testified as follows:

The Witness: I would like to correct a statement that I made on pages 3474 and 3475 of the transcript. I said on page 3474 that while APDA had already placed, as of last March, a substantial amount of orders for test facilities components there still remains a substantial amount of such orders unplaced.

Actually, if you will compare Acker Exhibit No. 6, which lists the components to be purchased by APDA for components testing and then turned over to PRDC with Acker Exhibit No. 20, which lists the material on order last March, you will see that some 90 percent of the items to be purchased in terms of their estimated cost without contingencies are in fact on order by APDA.

The items of equipment which are not on order shown in Acker Exhibit No. 6 are the element transfer rotor and drive, the reactor plant instruments, accessory electric equipment and the initial operating supplies.

[3487]

Also on page 3475 where I referred to the core and the pumps not being on order, I was referring to APDA, whereas I should have been referring in

the context to PRDC. These items are ones that will be ordered by PRDC except for one sodium pump which APDA is buying and which on Acker Exhibit No. 20 is shown to be already on order.

The Presiding Officer: Very well, Mr. Acker. Did you get that, Mr. Sigal?

Cross Examination—Continued by Mr. Sigal

Q. I am not certain that I got all of what Mr. Acker said because he started off before I was aware of what he was talking about. If I understood you correctly, Mr. Acker, you were listing the items that were on order as of March 4th, was it? A. Whatever it was.

Q. 1957. The ones that were not on order. You do not intend, I gather, from what you said, to change your earlier testimony yesterday to the effect that no substantial amount has been placed on order since March 1957. A. No, but I do want to change my testimony to the effect that some substantial amount still has to be placed on order. The gist of what I am saying now is that I was incorrect in my statement and that there is not a substantial amount still to be placed on order which was not on order last

[3488]

March.

Mr. Claytor: By APDA.

By Mr. Sigal:

Q. Only with reference to APDA? A. That is right. That is where the confusion arose.

Q. Only with reference to the list in evidence on Acker Exhibit 20 to which you are now referring. A. Yes, but of course that lists all the items that APDA will order for the test facility and turn over to PRDC.

Mr. Sigal: Will you read that?

(The answer was read by the reporter.)

By Mr. Sigal:

Q. Acker Exhibit 20. A. Yes.

Q. And the other items that you mentioned in your testimony a moment ago are in addition to those items? A. No, those are the items on Acker Exhibit 20 which are not yet on order.

Mr. Claytor: Could I correct that? We are referring to the wrong exhibit. It is Acker Exhibit 6 which lists all the items and Acker Exhibit 20 which lists the items which were already on order.

By Mr. Sigal:

Q. To which exhibit are you now referring other than 20? A. I am referring to Acker Exhibit 6. The items that

[5463]

I have listed as not on order are those shown on Acker Exhibit 6.

Q. What you want your testimony to show now is that so far as what APDA is obliged to turn over to PRDC there is not now a substantial amount of material and equipment to be put on order. A. That is right. In fact, in excess of 90 percent of the dollar value is already on order.

Q. You have no knowledge of when those items will be delivered? A. I have not as to the specific items except in the case of the reactor vessel and plug.

Q. We were asking at the close of the testimony yesterday, Mr. Acker, certain items that Mr. Radley had mentioned in his testimony. A. Yes.

Q. I think your last comment to one of my questions was that it was unreasonable. A. I will do my best to give you an honest answer. I gave you an honest opinion yesterday.

Q. Now, Mr. Radley pointed out that your statement states the cost of engineering design and expenses at $900,000. He stated that his opinion is that that figure should be at least twice as high. Are you still standing on the figure of $900,000 for that service?

[3490]

A. Yes, we are, Mr. Sigal, and here again we have the highest regard for Mr. Radley and his ability in his field, but I would like to say in fairness to our presentation that I think Mr. Radley again is talking in terms, when he makes these comparisons, of a one-organization project where one organization does the whole job starting with the engineering, conceptual design and carrying through the construction. Here we have two organizations involved and Mr. Radley could not have this knowledge prior to his testimony.

Q. Mr. Radley was basing his testimony on your testimony and on the material submitted by PRDC. A. There are things, however, there are factors which do not appear in my testimony which I am sure would have in-

fluenced Mr. Radley in his thinking in making these comparisons if he had had them before him. Those items I would like to point out to you.

Q. Are you now talking about engineering design expenses? A. Yes, I am.

Q. What do you allocate to APDA expenses for engineering design in respect to the PRDC reactor? A. Of course, APDA has done all the designing and a great part of the engineering in connection with the reactor project. They have already spent $2 million through 1956, at which time more than a third of the work had been done.

[3491]

I do not have a breakdown of exactly what APDA had spent on engineering and design, but I would like to point out that in addition to our $900,000 that they have done a very substantial amount of engineering design work and will continue to do so, which does not appear in the construction estimate or cost of the project. In addition, I would like to point out that again the Commonwealth associates who are doing the engineering and design work to be undertaken by PRDC, are doing the job on a no-profit, no-overhead basis. If we had engaged an engineering firm on the basis of profit and overhead we estimate that it would have cost us $500,000 more and I think that is fair to assume that Mr. Radley in his considerations assumed that we would engage or that this engineering and design work would be done on the usual profit basis.

Q. Now, presumably we can get Mr. Radley to testify, I assume, and Mr. Radley based his estimates and opin-

ions on what PRDC offered in this case. A. That is right.

Q. On the evidence, on your statements, on exhibits and whatever else there was in the case. Now, if Mr. Radley and no one else presumably can come to any conclusion from what is in the case, Mr. Acker, then it is obviously impossible to arrive at any conclusion as to what the cost of this project will be. A. Well, I agree with you fully as to what you say on Mr. Radley. If these items were not in evidence in the case he

[3492]

couldn't possibly have knowledge of them.

Q. Now, Mr. Acker, you are offering an opinion now that if the Commonwealth Associates did this on the basis of a profit and overhead that the cost would be $500,000 over the $900,000 item. A. That is right.

Q. Do you have anything to back that up? Do you have any material to back up your opinion that it would cost $500,000 more? A. Yes, I have the opinion of the staff of APDA, and my own knowledge of what engineering firms charge for the profit and overhead. My own company is now engaging an engineering firm on a twice-payroll basis which is materially in excess of what the charges are under this contract.

Q. Do you have personal knowledge, Mr. Acker, of what items went into the $900,000 figure that has been submitted heretofore and what items would go into the $500,000 figure that you say would have to be added if these other considerations were involved, namely profit and overhead expense? A. I say, Mr. Sigal, that the

$900,000 is our best estimate of what the Commonwealth Associates' direct payroll costs will be.

Q. You mean it is your estimate? A. May I finish?

Q. Or the Commonwealth Associations'? A. Our combined estimate based on a manhour study.

[3493]

Q. Then you don't have an estimate from Commonwealth Associates of what their charge for engineering design and expenses will be, is that correct? A. No, because, as I said, it is on the basis of reimbursable direct costs of the figure of $900,000 is an estimate of what that will amount to to cover the whole job on the basis of the number of manhours that they estimate the job will require.

Q. That is your estimate? A. That is their estimate.

Q. Do you have a document from Commonwealth Associates stating the basis for their estimate? A. I do not know if there is such a document in existence, Mr. Sigal.

Q. So far as the figure you mentioned for APDA is concerned, that certainly goes back, the figure you mentioned includes expenses going back to 1954, doesn't it? A. That is right.

Q. Substantially before this particular reactor was licensed or a permit was issued by the AEC in this case and substantially before you applied for a permit in this case, is that correct? A. Well, I don't want to be bound to the word "substantially", but before, certainly.

Q. And that, of course, covers the general experimental

[3494]

work that APDA was doing on fast reactors. A. It included a lot of design work as well, Mr. Sigal, directly related to the definitive reactor plan for this project.

Q. Directly related to what? A. To the definitive reactor plan for this project.

Q. Are you saying, Mr. Acker, that in 1954 you had a definitive project to place a reactor at Lagoona Beach?

[3495]

A. No, I am not saying.

Q. Then it could not have been a design for this particular reactor that we were working on in 1954? A. It most certainly could. Much of the engineering and design work which they did was directly related to the reactor design as it is now contemplated and to be built.

Q. But it also included general experimental development work on fast reactors? A. Yes, such as you would have to do in preparation for any reactor project.

Q. Now, Mr. Acker, I assume you are not familiar with any other reactor projects than PRDC's; is that correct? A. Except in general, Mr. Sigal.

Q. By "in general", you mean that you know that there are other reactor projects in existence? A. Oh, much more than that, Mr. Sigal.

Q. You have no personal knowledge of other specific reactor projects, do you? A. Certainly I have.

Q. To what extent? A. Mr. Sigal, there is a great deal of literature about all of these projects and I have kept myself informed in general as to the character of these reactor projects.

Q. You are now talking about in general, the reactor projects in general, not with respect to the specific problems

[3496]

construction and design? A. Not through my personal knowledge, but I have through discussions with people in the industry.

Q. All right.

Now, Mr. Acker, Mr. Radley testified with reference to your estimate of $34,500 for a waste disposal system. He testified that that was unlikely that an adequate waste disposal system for a reactor of this type and size could be obtained for any amount close to that estimated. A. We couldn't agree more with Mr. Radley. This is clearly in error.

Q. It is an error? A. An error.

Q. You have changed it? A. Yes, we have.

Q. Where does it appear? A. Our estimate now is two hundred thousand dollars.

Q. Where does that appear? A. It does not appear except as I am stating it for the record here today. We have not modified our construction estimate.

Mr. Morrisson: Excuse me just a moment.

What is this estimate you were changing?

The Witness: The waste disposal system and we say we cannot agree with Mr. Radley more. It is clearly an error,

[3497]

and we have modified our estimate to the effect of a cost of two hundred thousand dollars.

By Mr. Sigal:

Q. Is that the only item in your estimate that you changed? A. We haven't changed any item nor estimate as yet.

Q. I am sorry. A. We have not changed any item nor construction estimate as yet, Mr. Sigal.

Q. Do you mean you haven't even changed this item? A. We haven't changed any, nor construction estimate.

Q. What is this two hundred thousand dollar figure that you just gave? A. The two hundred thousand dollars is our present estimate of the cost of this project. What I am saying is that we have not changed any item in the estimates as submitted in the proceeding.

Q. You mean you haven't changed any exhibit with respect to your estimate? That is what you mean? A. I stand corrected.

Q. I see.

Are you suggesting, then, that you have changed your estimates in regard to various items on your construction items?

[3498]

A. In our own thinking, you mean?

Q. Yes. A. Why, certainly, where we know that there are changes. Some of them are reflected in exhibits which are in this proceeding, which have been introduced in this proceeding.

Q. I am sorry, Mr. Acker. I am not aware of just what exhibits you are indicating as showing changes in your estimates. A. We submitted an exhibit yesterday showing overages on certain items.

Mr. Claytor: Acker Exhibit 26.

The Witness: Obviously where we have already incurred overages as to certain items, the overall construction estimate must ultimately be modified.

By Mr. Sigal:

Q. We must be using words with different meanings. Obviously it is no longer an estimate when you have already paid out the money for an item. I am now talking about items which are not yet paid for, for which there is not already a specific commitment in dollars and cents. Now, with respect to such items have you changed your estimate as to their probable cost? A. Not as yet.

Q. Have you changed the items as to the probabilities,

[3499]

at least with respect to your thinking about them? A. We know, of course, that there is an exposure to increases as to some items which have not yet been placed on order.

Q. Now, you have just indicated that you have changed your estimate with respect to the waste disposal system from $34,500 to two hundred thousand dollars? A. That is right.

Q. Can your name any other items which you have changed similarly? A. No, I can't name any other items where there has been as yet a specific change made.

Q. The waste disposal system is the only one, then? A. That is the only one where a specific change has been made and agreed upon.

Q. Do you have a design for that waste disposal system? A. I think we have a conceptual design. I cannot say as to whether the design has been completed.

Q. Let me ask you this:

Do you have the design in any such form that Mr. Radley could offer an opinion on it as to its cost? A. I believe we have sufficient information and definitive conceptual design so that he could offer an opinion.

[3500]

Q. Do you have a design of any nature to offer us now? A. Not here, no; I haven't any such thing available here. The two hundred thousand dollar estimates listed are detailed so that I think that he could make an intelligent appraisal of our figure.

Q. May we have copies of those elements?

Now, Mr. Acker, looking at this revised estimate for waste disposal equipment.

Mr. Morrisson: Again could we have this marked, Mr. Examiner, with an identifying number so that we won't confuse all these papers?

Mr. Claytor: I suggest that a paper consisting of a single sheet entitled "Revised Estimate of Waste Disposal Equipment", be marked Acker Exhibit 27.

The Presiding Officer: That will be received for identification. That will be Arabic 27.

I noted that the Acker was Roman XXVI in the record yesterday. We want to correct that.

(Acker Exhibit No. 27 was marked for identification.)

By Mr. Sigal:

Q. Mr. Acker, this exhibit identified as Acker 27 gives a list of projected costs of certain elements of the

[3501]

waste disposal equipment. A. Right.

Q. As is obviously on the face of this exhibit it does not describe the elements, give their dimensions and materials and so forth so that it would be obviously impossible to determine the reasonableness of this estimate.

Now, I ask you, do you have any other material describing your waste disposal system? A. There is such material available, but I do not have it here.

Q. I see. And you do not, I assume, have personal knowledge so as to be able to describe it yourself? A. That is true, Mr. Sigal.

Q. Do you have any knowledge of how this compares to waste disposal systems that have been built for other reactors? A. No, I do not.

Mr. Sigal, could I give you a figure which you asked me for before, which I said I did not have available? You asked me what the allocation of engineering and design costs to PRDC job by APDA is. APDA has actually spent, alloted to engineering design on the PRDC job, through 1956, $977,224. Its budget expenses for the 1957 through 1958, the PRDC construction period for engineering and design, is $781,762, making a total of $1,750,000-odd.

[3502]

Q. Going back to what year, Mr. Acker? A. 1954.

Q. 1954? A. Yes, but if you will take just what they propose to expend during the construction period and add it to our own estimate of our own engineering design, you will see that we can readily agree with Mr. Radley that the overall engineering design expenditures on this

job will be in the nature of a minimum one million eight hundred thousand dollars.

Mr. Morrisson: Mr. Examiner, I assume that Mr. Acker was reading from a document which I suspect is a document of which I already have a copy, entitled, "Actual and Anticipated Expenditures by PRDC and APDA, Combined, Applicable to PRDC Reactor Project."

I intend to ask that that document be marked for identification in any event, and wonder if it might not simplify this to have it marked now.

Mr. Claytor: I ask that the document described by Mr. Morrisson be marked for identification as Exhibit Acker No. 28.

The Presiding Officer: The document so described will be marked Acker Exhibit 28 Arabic, for identification.

(Acker Exhibit No. 28 was marked for identification.)

[3503]

By Mr. Sigal:

Q. Referring to Acker Exhibit 28 for identification, the figures you have just read are described as follows:

Item C-1, and item C-2, it is stated that APDA actual expenses for engineering and design, in addition to those included in the Commonwealth Associates estimate, are $977,224, and that is derived as this exhibit shows by taking simply eighteen percent of a figure of $5,400,000-plus, which is called research and other test expenses; is that correct, Mr. Acker? A. That is right.

Q. So this is some sort of rule of thumb by which you

determine how much is applicable to the PRDC engineering and design, and how much is applicable to other matters?

[3504]

A. It is a percentage which reflects a study by each year, 1954 through 1956, of the allocation of APDA's costs between engineering and design and other research and test expenses and that is a composite percentage reflecting the results of those studies.

We think it is a comparatively reasonable allocation of the total cost to engineering and design expenses.

Q. But it is still more or less some sort of rule of thumb that you apply in order to arrive at this figure? A. No, it is more than a rule of thumb. It is based on actual studies of the direct costs chargeable to these specific expense accounts.

Q. You are not personally familiar with the accounting details or determination of these costs, are you? A. I know how they were determined, Mr. Sigal, but I did not sit down and do it, myself.

Q. Nor did you examine the figures from which these were derived? A. No, I did not.

Q. And you have no personal knowledge of what is covered by this item research and other test expenses? A. Well, to the extent that I have knowledge of the work done by APDA, yes.

Q. Well, what does research and other test expenses cover?

[3505]

A. Well, APDA is conducting research on many items in connection with this reactor project.

Q. And it is also conducting research with regard to matters not relating to this reactor project, isn't it? A. Not in this period that we are talking about, no.

Q. Not at any time up to 1956 did they concern themselves about anything else but PRDC? A. That is right.

Q. PRDC wasn't in existence in 1954? A. Well, again we are talking about terms. Everything that APDA has done up to now has been directed to the formation of PRDC and to the project which it is now carrying forward.

Q. APDA, according to the record, according to your own testimony, Mr. Acker, was concerned in general, at least in part, with developing fast reactors? A. That is right.

Q. And it is your opinion then that anything dealing with a development of fast reactors has a bearing on the PRDC project? A. There is no question about that, Mr. Sigal. I will put it this way: that I think PRDC if it had been formed in 1954 would have had to go through exactly the same motions that APDA was going through to cover exactly the same fields.

[3506]

Q. Mr. Acker, are you offering an opinion as a scientist in this matter? A. As a scientist?

Q. Yes. A. I don't think it needs a scientist to offer that opinion, Mr. Sigal.

Q. You mean it doesn't need a scientist to determine what sort of experimental and developmental work is required? A. That isn't the question that I am directing myself to. I am saying that whatever that research and development work, or test work, might be, that PRDC would have had to go through the same thing that APDA

is going through in preparation for the design and construction of this reactor.

Q. You are offering that, I gather, as your opinion, Mr. Acker? A. That is right.

Q. All right.

Now, Mr. Acker, looking at the second item under C, it states that APDA budgeted expenses for 1956 and 1957 are $781,762. Does that relate to engineering and design expenses? A. That does.

Q. All right.

Then, it says:

"This is eighteen percent of sixty-six and two-

thirds percent of six and a half million dollars which is budgeted for research and other test expenses."

Now, that, of course, is projecting this matter into the future? A. That is right.

Q. How do you arrive at eighteen percent of sixty-six and two-thirds percent? A. By the same kind of study as the prospective charges applicable to other research and test expenses, and to engineering design.

Q. Why do you take— A. Mr. Sigal, let me say this: That we have been asked to make this estimate and we have made it in accordance with our best judgment.

Q. You didn't make the estimate, did you? A. I did not, no.

Q. All right.

Now, I am asking you what is this sixty-six and two-thirds percent item? A. That is the portion of the pro-

jected expenditures research and other test expenses for the years 1957 through 1959, applicable by APDA to PRDC.

Q. Applicable in general, not merely to engineering and design?

[3508]

A. No, they aren't. In general. Now, we are saying that of the amount of APDA's expenditures applicable to the PRDC job, eighteen percent will represent engineering and design, and that is our best estimate.

Q. And this eighteen percent for those years is carried forward from the experiences you had for prior years? A. That is right.

Q. In determining what engineering and design expenses would be? A. That is right.

Q. So it isn't related to specific knowledge, as to how much you will actually be required to spend for engineering and design? A. It can't be because we are talking about the future, Mr. Sigal.

Q. Now, to what purposes will the balance of one-third of the six and a half million dollars be devoted? A. To research work in other fields than directed at this particular project. It would cover their advanced planning projects.

Q. So then this one-third of six and a half million dollars will be devoted to matters other than the PRDC project? A. That is right.

Q. Now, are you in any better position than you were yesterday, Mr. Acker, to tell us what those projects are

[3509]

which will be covered by this one-third? A. My under-

standing is that those projects relate to research and development of plutonium fuel cycle; in other words, the use of plutonium as a fuel in a fast breeder reactor as against uranium.

Q. That is what you said yesterday? A. Yes.

Q. You are not adding anything to what you said yesterday? A. No.

Q. Now, I call your attention to item B, on Acker Exhibit 28, which is called administrative and overhead expenses. A. This apparently charges to PRDC $2,170,000. It is not clear on this statement for what period that is intended. Can you tell us?

Q. The figure of $2,170,000 is the estimate of PRDC's administrative and overhead expenses during construction period of the reactor.

Q. All right.

Now, this exhibit indicates that the estimate of the expenses has been increased to the present figure from $1,816,000? A. That is right. That is what I testified to yesterday.

Q. Yes.

[3510]

A. In connection with the stretchout period.

Q. All right.

Now, what does it cover. What does this additional item or roughly $360 thousand cover? A. It covers salaries and other overhead expenses.

Q. For what period of time? A. For the additional nine months which I testified to yesterday.

Q. Now, you have item A, estimated plant costs of

$31,675,000 on this Acker Exhibit 28, an increase of $460 thousand over the previous estimate? A. Yes.

Q. That refers to financing costs, doesn't it, that item of $460 thousand? A. I didn't understand the question.

Q. What does that item cover? A. That is the item I testified to yesterday in application Exhibit XLIII, the new estimate presented to PRDC by Commonwealth Associates reflecting the additional administrative and overhead costs because of the stretchout of the construction period.

Q. I asked you what does it cover. You have an item of four hundred thousand dollars—some applicable to administrative and overhead expenses. Can you break the figure down?

[3511]

A. Yes, if you will give me some time.

Q. Pardon? A. If you will give me some time. You are asking me to break down an increase, so I would have to compare the new construction estimate with the old and show you the difference in the figures, which I will be glad to do.

Q. Is there any figure involved now showing how that item is broken down? A. How the item of increase—

Q. Yes. A. No, it is not presented in that way. There is the old estimate and the new estimate and to get the specific increases in each individual item you would have to compare the two estimates which I will be glad to do.

Q. All right.

Mr. Claytor: May I suggest that we do it at the recess.

The Presiding Officer: We will be in recess for a minute or two.

(A short recess was taken.)

[3512]

The Presiding Officer: The hearing will be in order, please.

Mr. Acker, were you able to make the calculation during the recess that Mr. Sigal desired?

The Witness: I can give it to him right now.

The Presiding Officer: All right, sir.

The Witness: Mr. Sigal, you have asked me for the breakdown of the $450,000 increase in the construction estimate of Commonwealth Associates. That is made up of a $300,000 increase in interest during the construction period and $150,000 increase in local taxes, making the total of $450,000.

By Mr. Sigal:

Q. Now, did you refer to this $450,000 before as administrative and overhead expenses? A. What is that?

Q. Did you refer to this $450,000 before as administrative and overhead expenses? A. If I did it was a mistake.

Q. I see. A. It was a slip of the tongue. There is an increase in administrative expenses from $1,816,000 to two million some dollars.

Q. Maybe my recollection was not clear. I thought you had solidified that amount. A. No.

[3513]

Q. All right. Then, Mr. Acker, apparently, although this estimate is pretty fresh, dated July 31, 1957, it doesn't

include, for example, the $200,000 figure that you indicated earlier for your increase in estimated costs of the waste disposal system. A. That is right. It does not include any modification of the original estimate except to the extent that I have indicated.

Q. Well, now, what is the reason for not indicating such increases which you have already determined will occur, Mr. Acker? A. It doesn't seem essential to us to modify the whole construction estimate for one item, a known increase from $34,500 to $200,000.

Q. You saw fit to make other changes. You saw fit to include an item of $150,000 for local taxes. Now, isn't a $170,000 increase for the waste disposal system a considerable item that is worth some attention? A. Mr. Sigal, I take it when we know more about our exposure to other increases over our estimated costs that we will, for our own purposes, modify our construction estimate and I want to call attention again to the fact that we have a very material margin over and above our present estimated cost to cover the kind of contingencies that we are talking about.

[3514]

Q. Well, Mr. Acker, PRDC's own interest isn't the only determining factor in the question of whether or not you will reveal to the Commission what your costs are. It is your obligation to reveal to the Commission what your estimated costs are so that the Commission may determine whether or not you are financially responsible. I am now talking about PRDC, not Mr. Acker. Don't you think under those circumstances that you are under an

obligation to reveal what PRDC has already found to be necessary, such changes as PRDC has already found to be necessary in its estimates? A. Mr. Sigal, PRDC will meet all of its obligations so far as revealing its costs are concerned, but I would like to suggest that we could make a new construction estimate every day, every time there is some new element that is entering into the picture, and how often do you do it?

Q. I don't know how often. A. We did it in this case to indicate what the effect of the stretch-out of the construction period would be, assuming that the balance of the estimate remained the same. We did it so that the exhibit would tie in with the other exhibits in this proceeding.

Q. Mr. Acker, you have offered some supplemental testimony? A. Yes.

Q. Which has changed much of what you testified earlier

[3515]

in a number of respects. These changes presumably were brought about by changes in circumstances since you last testified. Why do you consider the construction estimate to be somehow immune from such changes, at least so far as revealing what is in your mind or the minds of PRDC officials at this time with respect to your prospective costs? A. I do not consider it to be immune, Mr. Sigal. I am saying that for practical reasons you could change your construction estimate every day and it doesn't seem to us that that is essential inasmuch as we show from the standpoint of our resources such a material margin over and above the indicated requirements.

Q. How do you know or how is anyone else to know, Mr. Acker, whether or not your reserves are sufficient to meet the possible increases in costs if you are unwilling even to indicate here what you now expect those costs to be?

Mr. Claytor: I object to that question. There is no indication of unwillingness to reveal what costs are to be and, Mr. Examiner, this is just developing into a philosophical argument between Mr. Sigal's approach to the whole problem and that of the witness. It seems to me that that line has gone far enough.

Mr. Sigal: This is quite basic to this case, Mr. Examiner. The question of what it will cost to build this reactor obviously goes to the question of the financial

[3516]

responsibility of PRDC. This witness has already indicated with respect to one item, only one item, a substantial change in estimated cost. He has already indicated that there will doubtless be changes in other costs with respect to construction.

The Presiding Officer: You may proceed. I am not stopping you.

By Mr. Sigal:

Q. Will you answer the question, Mr. Acker? A. May I have the question read?

(The pending question was read by the reporter.)

The Witness: Mr. Sigal, nobody ever knows, looking into the future, whether a reserve is sufficient. I would be the first one to admit that. This

is a judgment matter and it is the same kind of situation that any corporation finds itself in when it is beginning operation: What do you provide, how often do you review and change your construction estimate during the course of construction?

By Mr. Sigal:

Q. Mr. Acker, you yourself, that is, PRDC, has already elected to review its construction costs. A. I beg—

Q. May I finish my question, please. You have offered in evidence here a letter marked Exhibit XLV, which indicates a change in your construction costs and you have offered other related exhibits showing changes. Now, doesn't that reveal that

[3517]

you have been reviewing your estimated costs? A. I stated previously, Mr. Sigal, that this new estimate of Commonwealth Associates was made to reflect the increases as a result only of the stretch-out of the construction period.

Q. But, be that as it may— A. That was the purpose of it.

The Presiding Officer: Just a moment, Mr. Sigal.

The Witness: That was the purpose of it and the Commonwealth review does not purport to be a re-estimate of the reactor plant cost.

By Mr. Sigal:

Q. Then, Mr. Acker, is it correct to say that your Exhibit, Acker Exhibit No. 7 and its related exhibits, which purport to show your construction estimates, do not reflect as of today the expectations of PRDC with respect to its

construction costs? A. I will say, Mr. Sigal, that it is entirely possible that that cost estimate would be exceeded.

Q. Then, your answer to my question is those exhibits do not reflect the expectations of PRDC with respect to construction costs as of today. A. I think we are getting down to a question of terminology. I would like to say yes, that they reflect our expectations, our hopes certainly, but I am perfectly willing

[3518]

to admit that the estimates may be exceeded.

Q. No, Mr. Acker. That is not what I am asking you. In the light of your testimony is it not correct to say that your estimates are not now correct with respect to your own expectations? A. I don't think I will say that.

Mr. Claytor: That question has been answered.

The Witness: I don't know, Mr. Sigal.

By Mr. Sigal:

Q. You have already testified, Mr. Acker, that there is a two hundred thousand dollar item which is not included in those estimates? A. It is entirely possible that some other item may be reduced by two hundred thousand dollars, Mr. Sigal. We don't know. We are talking about the future.

Q. You also indicated earlier, Mr. Acker, that there were other items than the waste disposal system in which you anticipate that there will be increases in costs? A. That is right.

Q. But you have declined to indicate what those items are? A. I have declined because they have not been definitively reviewed as yet.

Q. What are those items? A. I think there is an exposure to an increase as

[3519]

as against the construction estimate in the cost of the core. There is an exposure to an increase in the cost of the sodium pumps.

I think there may be an exposure as to some increase in the cost of the cask car.

You already know about our revision of the waste disposal system estimate.

We think there is an exposure to an increase in the cost of the boiler.

Those are the principal items which have been reviewed in a preliminary way.

Q. I am sorry. A. Those are the principal items that have been reviewed in a preliminary way.

Q. They have been reviewed, you say? A. In a preliminary way.

Q. What does your preliminary review show as to the amount of the increase over your previous estimates? A. I am not in position to testify to that, Mr. Sigal, because the review has not been completed.

Q. I am sorry; I missed that. A. I am not in a position to testify as to that because the review has not been completed.

Q. I don't know that I understand you. You did say you made a preliminary estimate?

[3520]

A. I didn't say preliminary estimate. I said preliminary review.

Q. And none of it has been completed? A. We have no definitive figures as yet as to what these overages may be in those categories.

Q. You are not in any position to give us any preliminary figures? A. No.

Q. Well, now, Mr. Acker, Mr. Radley testified that with respect to the PRDC estimate for preoperational testing that the one hundred thousand dollars allocated for plant equipment adjustments is too low.

He testified that in his experience this one hundred thousand dollar allowance for plant equipment adjustments should be doubled or tripled.

From your testimony I conclude that PRDC has made no change in its estimate for plant equipment adjustment. Am I right on that? A. That is right, and PRDC does not think that that is necessary.

Q. Why? A. Because particularly for the reason which Mr. Radley could have no knowledge of that APDA will run this test facility as to very important components of the reactor plant and will during that period do plant adjustment work which is

[3521]

not reflected in the one hundred thousand dollars of PRDC's costs.

APDA will do that work at its own expense.

Q. Then that one hundred thousand dollars should not have been there? A. No, because APDA is not going to test and adjust the whole plant, Mr. Sigal.

Q. This is only for preoperational testing, not the whole plant? A. That is right.

Q. How do you distinguish between the areas in which

APDA and PRDC will operate with respect to preoperational testing? A. APDA will operate the test components as to which we have testified in this proceeding previously; the reactor vessel proper; the sodium loop and the nuclear portion of the plant.

Q. What else is there in preoperational testing besides that? A. The rest of the plant?

Q. You mean testing whether or not the concrete work is solid? A. Oh, no.

Q. What do you mean by preoperational testing other than what you have already testified to?

[3522]

A. There are boilers, there are heat exchangers, there are pumps, there are many other portions of the plant that APDA is not actually responsible for.

Q. In your concept, preoperational testing includes testing the ordinary boilers in the building? A. My preoperational testing would be testing the whole plant.

Q. The whole plant? A. Yes, sir.

Q. Regardless of whether or not they are directly related to the reactor, or not? A. That is right.

APDA estimates that it will expend during the test operation for test operations specifically about $725 thousand.

Some portions of that, and I do not know the figure, would obviously be for plant adjustments in this category of expense items.

Q. That particular breakdown you have mentioned does not appear anywhere in the record as you have now, does it, Mr. Acker? A. The $725 thousand that I spoke of?

Q. How much will be allocated to APDA expenses for plant equipment adjustments? A. No, that figure is not broken down in the record, Mr. Sigal.

[3523]

Q. Or how much PRDC will do? A. The PRDC figure is one hundred thousand dollars, estimated.

Q. All right.

Now, is the PRDC figure of $350 thousand—what are you looking at, Mr. Acker, for your figure of four hundred thousand dollars? A. One hundred thousand dollars.

Q. I thought you said four hundred thousand dollars? A. One hundred thousand dollars.

Q. All right.

The estimate for preoperational testing, $350 thousand. A. You are talking about the overall figure?

Q. Yes. A. Yes, by PRDC.

Q. Now, is that all for testing other equipment than the nuclear equipment in the building? A. For testing other equipment than that which will be tested adjusted and so forth by APDA.

Q. And APDA will test and adjust all the nuclear equipment in the building? A. Substantially, yes.

Q. Everything in effect which is within the reactor vessel? A. No, now I cannot say, Mr. Sigal, as to just where

[3524]

this dividing line is. I am not prepared to state that.

What I am stating is that APDA will do a substantial amount of the plant equipment adjustment.

Q. Now, Mr. Acker, has PRDC prepared and submitted to AEC any sketches or designs in addition to what is now in the record of this case, with respect to the reactor building or its parts? A. Not to my knowledge.

Q. Well, now, is it your opinion that on the basis of the

materials now in the record it is possible to arrive at a reasonable estimate of the cost of this reactor?

By materials in the record, I mean the sketches and designs and any other information which PRDC has made available. A. You mean by some outside individual?

Q. Yes, say the AEC's own staff, could they make a reasonably precise estimate on the basis of the information that PRDC has supplied? A. That is a difficult question, Mr. Sigal. I just don't know, frankly, but I would think that with the information which is available in the record and by discussion with PRDC people, that they could make a reasonable evaluation of the estimated cost of this project.

Q. Well, Mr. Acker, I call your attention to the testimony of Mr. Radley on page 3325 of the record. A. Is this in his direct testimony or in the cross

[3525]

examination?

Q. In the cross examination. It is in the transcript. A. What was the page number, Mr. Sigal?

Q. 3325. A. I have it.

Q. You will note that after I questioned Mr. Radley with respect to why he couldn't give a precise estimate that he stated:

> "The sketches in APDA 115 are not adequate for one thing to show the size of the buildings. They are not described very completely. Therefore not very many connections any place. There are a great many uncertainties as to what is required in the project. There is a general lack of information throughout." What is your comment on that, Mr. Acker?

A. With respect to my previous answer, my comment previously was that I thought that there was enough information available in the record and by discussion with the PRDC people for an outside consultant, but I think it would be very essential to have a discussion with the PRDC people.

Q. Do you mean that they have information which you can't put down on paper? A. I think that that is entirely possible.

Q. You mean that they go out and build buildings without fixing dimensions of the buildings?

[3526]

A. I don't mean that, Mr. Sigal.

Q. Mr. Radley says there are not even dimensions of these buildings. You can't tell how big they are going to be. How can you estimate the cost if you don't know the size of the building? A. I think the dimensions could be made readily available.

Q. Why haven't they been made available? You tell us what this is going to cost and give us estimates more or less detailed. How is anyone outside to determine whether or not your estimates have any validity at all if you don't give dimensions or sufficient information to provide a check on your own statements? A. We have no objection whatsoever to giving dimensions, Mr. Sigal.

Q. Why hasn't it been done, Mr. Acker? A. Because it did not appear to be essential for this proceeding.

Mr. Claytor: It seems to me that the question is asking why PRDC has not introduced certain exhibits. I think you might address the question to counsel.

Mr. Sigal: It is a question of man who has com-

mand of all the necessary information. He said he does.

The Presiding Officer: Did he not just answer the question?

[3527]

Mr. Sigal: I am sorry.

The Presiding Officer: Didn't you just answer your question?

Would you read the answer?

(Thereupon, the pending answer, as heretofore recorded, was read by the reporter:)

By Mr. Sigal:

Q. You mean that PRDC decided, that it was not essential to put into the record for this case sufficient detail about its buildings that an impartial estimate could be made about the costs of that building? A. Mr. Sigal, there is no precedent for this proceeding as far as I know. As far as I know also there are no rules and regulations as to the amounts of detail that must be presented in submitting construction estimates to the AEC.

We have done the best that we could and have stood willing at all times to make a complete revelation of any information that anybody wanted to have and, if dimensions in some instances were omitted, it was not done with any idea of not making the information available, but just as a practical matter in submitting a great mass of detail in this proceeding.

Q. Well, there is no point perhaps in pursuing this any further, Mr. Acker, but it is obvious from the exhibits that you, yourself, have introduced here today that there

is a great amount of what might be considered even trivial detail

[3528]

which has been put into this record which you thought necessary, but apparently even though Mr. Radley pointed out to you many weeks ago that basic information was lacking with respect to the design of the building and other things necessary in order to check your estimates, PRDC hasn't thought it desirable or necessary or convenient to put any more information about those matters into the record; is that correct? A. It seems to me that the record will have to stand for itself. PRDC has not done that. That is true.

Q. What? A. That is true. PRDC has not put additional information into the record.

* * *

[3536]

Q. Now, Mr. Acker, you have testified this morning about the amount of cash which may be available to the company at the start of the operations and you referred not only to the amount shown on your auditor's reports but also to an additional

[3537]

amount of approximately $1,100,000, which, as I understand it, represents the difference between $4,100,000 at which the component test facility is included in the construction cost estimate and the $3 million shown as a contribution by APDA, a contribution in kind by APDA. If this is in fact to be an additional amount of cash available

to the company, can you tell us why it does not so appear on the auditor's statements which you have filed? A. I suppose, Mr. Morrisson, because it is indicated as an expenditure. It is an expenditure, however, which in fact will not be made and therefore will represent free cash. I think it very well could have been shown in that way on the auditor's statement. This is sort of a traditional situation in which APDA and PRDC originally evaluated the APDA contribution for the test components at $3 million. That figure was determined before APDA had made a complete estimate as to what the cost of these facilities might be and the fact is that the $3 million figure of evaluation of those facilities in our financial statements were carried forward and the estimated cost was put in at a higher figure, although it is in effect a sort of hidden reserve. We could very well have put the $3 million figure at $4,100,000, in which event it would have shown up as additional free cash in the statement.

Q. Well, is this because the assumptions which were given to the auditors would not reflect the true situation, or did the

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auditor make some independent determination that in his judgment this amount did not constitute cash available to the company? A. I think this is a situation, Mr. Morrisson, that we simply did not realize the effect of when we instructed the auditor in this way.

Q. When you instructed the auditor, you instructed the auditor how to handle this $4,100,000 item and the $3 million item. A. That is right.

Q. I see. What I was concerned about— A. And

something that the auditor did not see through and something that we ourselves did not get onto until we got into this proceeding.

Q. My reason for inquiring into it is that the Commission should naturally feel entitled to rely on the auditor's reports that you have submitted as showing the true cash position. You have stated that your true cash position is more favorable than is shown on the auditor's report. A. That is right.

Q. I was trying to get a clarification on the record as to why this is the case and I am still not entirely clear. Is it that you disagree with the auditor's treatment of this item? A. Now, we couldn't do that very well because we instructed

[3539]

the auditor as to what assumptions to make. We gave the auditor a construction estimate which did not indicate this difference between the estimated costs of these facilities and the evaluation we put on them. We gave the auditor a receipt item to take into account of $3 million from APDA and I wouldn't think that the auditor saw the effect of this because the auditor did not know specifically, did not specifically have in mind the $4,100,000 item.

Q. So that what you are saying is that you gave the auditor a construction estimate which included this facility in at $4,100,000. A. That is right.

Q. And you gave him a receipt item of $3 million. A. That is right.

Q. And based on those assumptions, he came up with the cash position. A. Right; and in all fairness, I think I should say that I don't think the auditor had the rela-

tionship between the $3 million figure and the $4,100,000 called to his attention. He did not have it in mind.

* * *

[3542]

Q. I would like to ask you, Mr. Acker, whether there has been any change in the prices for the items shown on Acker Exhibit 20 other than those procured by PRDC which have been

[3543]

carried forward into your new exhibit. A. Yes, there have, Mr. Morrisson, and I can give you the changes by items.

Q. All right. Do you have this written out on paper?

Mr. Claytor: No.

By Mr. Morrisson:

Q. You can read it into the record. A. As to item B-3 in the construction estimate, which is the hold-down plate and actuator, the order amount shown in Acker Exhibit 20 was $145,000 and the order amount in effect June 30, 1957, was $145,000.

Q. So there is no change. A. There is no change. Item C-1, the primary shield tank showed previously at $106,350 and as of June 30 at $120,020, an increase of $13,670. Item C-3, the index system and drives showed originally at $60,000, and now at $57,000, a decrease of $3,000.

Q. You skipped, I believe C-2 and C-3. A. I am coming back to that. C-4, two control rods, the original figure was $35,000, the present figure, $55,678, an increase of

$20,678. Item C-5, two control rod actuators, originally at $51,200, still at the same figure, showing no change. Item C-8, the offset element handling mechanism, the original figure was $190,500, the present figure $211,400, an increase of $20,900. Item D-1, one sodium pump, the original

[3544]

figure was $143,594, the present figure $175,981, an increase of $32,387. Item D-1, one check valve, the original figure $7,700, present figure $7,678, a reduction of $22. Item D-5, one sodium piping loop, the original figure was in at $55,628.

Q. That is not the figure I have here; A. But that was a typographical error and the figure in the APDA records is actually $59,628.

Q. My figure is $59,628.

Mr. Claytor: $59,628 in Acker 29 is the correct figure.

The Witness: The present figure is the same, so there is no change. Item D-6, six flow bracket flow valves, the original figure $14,635 and the present figure $14,865, an increase of $230. These items add up to a total in Acker Exhibit No. 20 of $813,597. As the amounts of the orders stood on June 30, the amount is $897,832 an increase in the order amount of $84,873. I would like to point out that the order amounts as of June 30, aggregating $897,000, compare with the estimate including contingencies in Acker Exhibit No. 7 of $973,908.

Now, the other large item included on Acker Exhibit No. 20 is the items C-2 and C-3, the reactor

vessel and rotating plug at a figure of $1,262,152. The amount of that order as of June 30 is indeterminate. It was at that time undetermined, and is as yet undetermined. The cost of the reactor vessel to the manufacturer, Combustion Engineering, has materially exceeded, I understand, the figure covered by their proposal and APDA's

[3545]

order. The excess or increase in cost has come about by reason of changes in design, additions to the vessel, the necessity of a materially increased amount of engineering, stress analysis and research in connection with metallurgy and so forth. To the extent that the increased cost has come about by reason of changes in design, additions and so forth, APDA now has under negotiations with Combustion Engineering an increase in the order amount.

This matter is in negotiation and I have no specific knowledge as to what the resultant increase will be. I would think it would be somewhere in the neighborhood of 30 percent or something in excess of that but I have no definitive figure because the negotiations have not been completed.

Q. That is an item which is expected to be delivered in the middle of January, next January, is that right? A. That is right.

Q. You expect that the negotiations will have been completed by that time? A. Oh, I am very certain of that.

Q. That covers, I think, all of the items on Acker

No. 20 which were APDA items. I believe the PRDC items are already included in this other exhibit, are they not? A. That is right.

* * *

[3557]

Q. This was the point I wished to clarify. I have two more questions, Mr. Acker. Can you give me a total for the amount which has been committed or expended by PRDC for research and development? A. Yes, the figure is $425,125.

Q. Committed? A. Committed, that is right, committed or expended.

Q. Committed or expended; and how much of that has been expended? A. $97,910. That is as of May 31, 1957.

Q. So that, as of that date the $5 million budgeted for this purpose had had somewhat less than half a million dollars committed? A. That is right.

Q. Now, Mr. Acker, one of the issues of financial qualification in this case is the qualification of PRDC to repay any Commission charges for special nuclear materials including, of course, the loss of those materials. First, are you in a position to give any estimates as to what the charges for loss of special nuclear materials might be or is this a

[3558]

matter which it would be better to ask of Mr. McCarthy? A. I think Mr. McCarthy could testify in more detail, but in general, as we see it, the exposure is not the loss of a whole core at an estimated figure, say, of $7 million, but

of some portion of that which might be more in the nature of a million dollars.

Q. Just to correct the record, is not the whole core valued at almost $8 million, $7,900,000 or something of that sort? A. I haven't a definitive figure. It is of that nature, $7 million or $8 million, whatever it may be. Obviously, we would expect that such potential loss could be covered by insurance through the private companies. In the event that that were not possible, of course, all of the unencumbered assets of PRDC would be available to meet such loss and, if the insurance question isn't resolved and some further protection of the government were required, then we would have to consider some form of guarantee by our member companies to the government.

Q. Have you been advised whether PRDC would have an insurable interest in the core? A. Not as yet.

Q. In view of the fact that the special nuclear material is owned by the government: A. We have not been advised on that as yet, Mr. Morrisson.

* * *

[3570]

KENNETH E. FIELDS was recalled as a witness, and, having been previously duly sworn, was examined and testified further as follows:

Cross Examination—Resumed by Mr. Sigal

Q. Mr. Fields, on November 18, 1956, the Atomic Energy Commission issued an announcement that it had established guaranteed fair prices to be paid for plutonium and uranium-233 produced in atomic reactors operated under license in the United.

[3571]

States and delivered to the Commission for the one-year period beginning July 1, 1962. You are aware of that announcement, are you not? A. Yes.

Q. That announcement stated with respect to the prices that for plutonium metal, the price would be $12 per gram; for uranium-233 nitrate, $15 per gram, of U-233.

It further stated, and I quote:

> "These prices are based on the estimated fuel value of the materials and are identical with those to be paid for these products at reactors abroad fueled with material supplied by the United States."

You are aware of that statement? A. Yes. That is my recollection of it, without looking at it.

Mr. Morrisson: I am showing the witness the text of the press release to which Mr. Sigal is referring.

The Witness: That is my recollection of it without looking at it in detail. If you wish me to verify it exactly, I suppose I can.

By Mr. Sigal:

Q. It would appear from that statement that the price of plutonium was based entirely on its estimated fuel value. Is that a correct conclusion, Mr. Fields? A. I don't believe it is a correct conclusion. That

[3572]

particular price was based on an estimated fuel value for plutonium. I don't believe the announcement excludes other prices for plutonium. At least, that is my recollection of it. I am not sure I understand your point.

Q. No. I said so far as this $12 guaranteed price for plutonium, that was based, was it not, on the estimated fuel value of plutonium? A. Yes, that was our basis at arriving at $12. It was an estimate of what its fuel value possibly could be in relation to uranium-235 costs.

Q. Then you say this was done in relation to the uranium-235 cost? A. That is correct. Actually, we have no experience on which to base what is an established value of plutonium in a reactor, in a power producing reactor.

Q. So when you say it is related to the U-235 cost, then what that means, if I understand you, is that you estimated the fuel value of plutonium to be related to the fuel value of uranium-235 as 12 is related to the price of uranium-235? A. As 12 is related to the price schedule, the so-called $16 price schedule, of uranium-235, not necessarily the fuel value of uranium-235. We are getting into something—Maybe that is the value of uranium-235 in a reactor over the long run and maybe it is not, as a fuel. That actually

[3573]

happens to be what we charge for uranium-235. If I can follow this just a second, the actual value that works out for uranium-235 in the years ahead may be different than the $16. It may be more valuable in reactors than $16. We are charging for it on the basis of full cost recovery.

Q. You are charging for uranium on the basis of full cost recovery? A. That is correct.

Q. You are? A. Yes, that is correct.

Q. And the prices of uranium which revolve around the $16 per gram figure, represent the cost of recovery? A. Yes, the cost of production.

Q. The cost of production? A. Yes.

Q. And inasmuch as you did not know the actual cost of production of plutonium, you estimated the price of plutonium by relating the estimated fuel value of plutonium to the non-fuel value of uranium; is that correct? A. To the known charge we make for uranium, yes. Actually, let me be sure the record shows that we do know what it costs us to produce plutonium.

Q. I see. A. Otherwise, that would stand.

Q. And was this price of $12 per gram for plutonium

[3574]

established in the light of your knowledge of the cost of producing plutonium in your own facilities? A. Well, we know the cost of producing uranium in our own facilities. The 12 was set without using that as a basis for the establishment of the $12 price.

Mr. Claytor: No. Plutonium.

The Witness: Plutonium. I am sorry.

By Mr. Sigal:

Q. Now, will you start over again? A. I will start over again.

The $12 price was set based on a calculation, an estimate, as to what plutonium would be worth compared to uranium-235 in a power producing reactor. It was set without regard to the actual cost to us of producing plutonium in our own plants.

Q. In your own plant? A. That is right. I say without regard. Of course, we know what our costs of producing plutonium are.

Q. You do not know what the cost of producing plutonium might be in a commercial reactor, do you? A.

There are no current operating reactors; that is true. You could estimate costs of producing plutonium, but then you have to make assumptions as to how much the power is worth and how much revenue you get from other parts of the plant before you could arrive at what the plutonium would be

[3575]

worth that you produced from that.

No, I would say that at this moment—Well, I would not know how to establish what its true fuel value will be ten years from now, plutonium.

Q. It is also true that you cannot determine the price of plutonium to be produced in a particular reactor without knowing, of course, the characteristics of the particular reactor? A. That is true.

Q. And would not the cost of producing plutonium vary, depending on the size and the power of the reactor? A. I would think so; yes.

Q. So that in one reactor, the cost of plutonium may be much greater than in another reactor? A. The cost of what?

Q. Of producing the plutonium might be much greater. A. Yes, I would think so. I would think so.

Q. Do you have any idea of the area of difference in the cost of producing plutonium? A. That would be so speculative. Some reactors aren't built to produce plutonium, yet produce a little bit.

I mean, they are not designed for the production of plutonium. They are not dual-purpose in that respect.

So the range of what it would cost to produce plutonium in any particular reactor will vary, depending on your

[3576]

in any particular reactor will vary, depending on your assumptions and on the type of the reactor.

I would submit that that is not, alone, the criteria, though, on which one determines the value of a product.

Q. We are now talking about the cost of production? A. Right.

Q. On May 18, 1957, exactly six months after the announcement we have just been talking about, AEC announced new guaranteed prices for plutonium, is that correct? A. I believe that was the date, yes. That is my recollection.

Mr. Morrisson: That is the date.

By Mr. Sigal:

Q. The second paragraph of this announcement—

Mr. Morrisson: Excuse me a moment. Let me hand the witness a copy of the announcement.

(A document was handed to the witness.)

By Mr. Sigal:

Q. The second paragraph of this announcement reads as follows:

"For purchases between now and July 1, 1962, the price will range from $30 to $45 per gram, depending on the plutonium-240 content of the material. For the year July 1, 1962 to June 30, 1963, a single price of $30 per gram will be in effect. These prices supersede all

[3577]

previous guaranteed fair prices for this material and details of the new schedule will be published in the Federal Register."

This announcement does not specify, as did the previous announcement, that the price was based on the estimated fuel value, is that correct? A. It does not specifiy; that is correct.

Q. It does say in the fourth paragraph of that announcement, as follows:

> "In making such extension, the Commission expects that the guaranteed fair price for plutonium will be reduced as dictated by consideration of the value of the material for its intended use by the United States and giving such weight to the actual cost of producing it as the Commission finds to be equitable, to a level based upon the fuel value of the plutonium in commercial power reactors."

That statement of criteria is taken from Section 56 of the Atomic Energy Act, is it not, Mr. Fields, which sets forth the criteria for establishing prices? A. I presume that is correct; yes. There is a section, though I have forgotten the number.

(A document was handed to the witness.)

The Witness: Section 56; yes. That is correct.

[3578]

By Mr. Sigal:

Q. Of course, that section was in effect before November 18, 1956? A. That is true.

Q. And presumably, then, the Commission used the same criteria when it determined the prices that it announced on November 18, 1956, did it not? A. The same criteria were in existence; yes.

Q. All right.

Now, inasmuch as the earlier announcement mentioned

only fuel value or estimated fuel value as the determining criteria, and the later announcement mentioned these various considerations other than fuel value, is it correct to say that there will be beginning as of July 1, 1962, two sets of guaranteed prices for plutonium, one of $12 per gram if the plutonium is to be used for fuel and one of $30 per gram if the plutonium is to be used for other purposes? A. That comes close to being the assumption with the exception of your latter point on $30.

Q. Would you explain that? A. I will explain it this way: The prices announced for plutonium, the $30 price, will apply to licensed power and research reactors in the United States. It is without regard to the fuel value in the United States.

You see, in the United States, by law, the title

[3579]

rests with the United States Government. It is contemplated in this period, between now and 1963, that the material we now obtain will be utilized for certain purposes, and the value for those purposes, as we determined on this May 18 price that would be established, that would be paid, the purchase price would be $30. We set that price by a determination related to its intended use.

Q. Yes, that is what the announcement says. A. Any plutonium that we purchase in the United States between now and then will have a value of $30 or between now and 1962, it may be, depending on the specifications, that you might pay more, up to $45, approximately, per gram.

Q. That is set forth in the statement in the Federal Register. A. Actually, the schedule set back in November was to set a price that we would purchase plutonium for

from the reactors that would be built in foreign countries, and as a part of cooperation agreements for purchase by us of plutonium. We had to set a price. We set at the same time a policy that any plutonium produced in foreign reactors would be devoted solely for peaceful purposes.

Consequently, we then had to determine a fuel grade price, in effect, for plutonium, which we determined to be $12, at that time.

Q. Let me get you straight there. Are you saying

[3580]

now that as of July 1, 1962, there will be two prices in effect? A. After that point, for that year.

Q. For the year beginning July 1, 1962? A. Yes, there will be two.

Q. There will be two prices in effect for plutonium? There will be $12 per gram if the plutonium is produced in a foreign reactor, and it will be $30 per gram if the plutonium is produced in a domestic reactor? A. That is correct.

Q. Is that correct? A. That is correct. I would only make sure the record would show that prior to that time there weren't two prices; there were an infinite number of prices depending on the characteristics of the material. Almost an infinite number, though not quite.

Q. Yes. Well, the prices that you mentioned are those that are now set forth in the notice in the Federal Register of June 6, 1957; is that right? A. Is that the right date?

Mr. Morrisson: That is the right date.

The Witness: That is it.

By Mr. Sigal:

Q. Now getting back to the situation as of July 1, 1962,

you say that inasmuch as the assumption is that all plutonium

[3581]

which the AEC will buy from foreign reactors will be used for peaceful purposes, therefore the price will be $12 because that is the estimated fuel value, but the plutonium produced in domestic reactors will be paid for at $30 because it will be used for other than peaceful purposes, is that correct? A. That is—Well, I would like not to refer to it quite that way. Because its intended use is different. It could be for purposes—for whatever purposes the Commission uses plutonium for.

Q. Whatever purposes other than the peaceful purposes to which foreign produced plutonium would be put? A. That is correct.

Q. Of course, the plutonium produced in foreign commercial reactors would be brought over to the United States, is that correct; for processing? A. Either that, or processed in facilities with which we agree, mutually, with the country, as to where it would be reprocessed.

Mr. Morrisson: Mr. Examiner, I have not interposed any objections so far to this line of questioning, because I wanted to see where it was leading. But it seems to me that what Mr. Sigal is trying to do here is to inquire into the reasoning for or the basis for, prices which the Commission has set. I certainly agree that he is entitled to address any questions that he wishes to address to the

[3582]

question of what action the Commission has taken and what that action means.

But this is certainly not a legislative inquiry into the justification for the action which the Commission has taken.

I agree, there is no question pending, so I am not making objection now, but I will be compelled to object to further questions which seek to go into the basis for action which the Commission has taken and published in the Federal Register.

Mr. Sigal: Just in general, so there will be no doubt about our purposes, we are not making any investigation as to the basis, the general basis, for the establishment of prices here. We are concerned here about the price that is to be paid to PRDC, and the probability of the continuation of that price during the period the PRDC reactor is operating. We have to go into this matter, into that subject, which, of course, is a basic one in this proceeding.

By Mr. Sigal:

Q. I would like to call your attention, Mr. Fields, to the statement in your testimony before the Joint Committee on Atomic Energy, of the Congress, on or about June 13, 1957. This appears at page 238 of the transcript.

Mr. Morrisson: What hearings are these, Mr. Sigal?

Mr. Sigal: On the Authorization legislation.

[3583]

(A document was handed to the witness.)

By Mr. Sigal:

Q. In response to a question from Representative Holifield, at the top of that page, you stated:

"During that year, 1963, that one year period from July 1, 1962":—

A. What page are you on?

Q. 238. A. I see it.

Q. I will start over again.

"During that year, 1963, that one year period from July 1, 1962 to 1963, there are only two prices: a $12 price if its intended use is for peaceful purposes, and a $30 price. There are no other prices for plutonium."

Mr. Fields, you make no distinction in this statement, and, so far as I can tell, you don't make that distinction in any part of your testimony, that the $12 per gram is to be limited to plutonium produced in foreign reactors, if that plutonium is intended for peaceful purposes. A. I can't answer the question. We have had a number of hearings with the Joint Committee. This point did come up. I am not sure it did come up in these open hearings or in executive hearings before the Committee. We have gone over this subject of prices fully with the Joint Committee. I am not quite sure—Well, excuse me, I am not quite sure.

[3584]

I certainly have recognized all along that what we were talking about was the foreign prices here. I don't know what would happen if someone in this country would say that their plutonium should be for peaceful purposes. We have not had the situation arise.

Q. I am sorry, I didn't get your last remark. A. I am saying I don't recall that we did discuss this particular aspect of this question in open hearings. It has been discussed, I am quite confident, with the Committee.

Q. From this statement, it would appear, would it not, Mr. Fields, that the plutonium for which you pay $30 will not be used for peaceful purposes? A. I believe that is a—Well, let's just see here. I would have to read the statement a lot more carefully than just right now in order to say "yes" on that. You would ordinarily conclude that that is what was going to happen. But what I should say is this, that the price we have established in this country is for its intended use. It happens to be $30 or higher between now and July 1 of 1962. It is not a foregone conclusion that every bit of that plutonium will end up in a military use, because we are using plutonium for other uses. But we are establishing a price on the intended use of our overall plutonium during this period. We may put plutonium in a power-producing reactor ourselves and we may not have gotten any from abroad during this period. It

[3585]

will be the same plutonium.

Q. Whether you get it from abroad or whether you get it locally, it will be the same plutonium? A. It will be the same material; yes.

Q. Of course, the price you are establishing is for just the one year, the price we have been talking about; that is, is the price just the one year, July 1, 1962 to June 30, 1963? A. Which price are you talking about?

Q. The $12 price and the $30 price. A. No, the $12 price applies from now through July 1, 1963, to any plutonium purchased from abroad.

Q. From abroad? A. Yes.

Q. I see. The $30 price applies— A. From now until July 1 of 1963 for certain grades of plutonium.

Q. For certain grades? A. In the period from now until July 1, 1962, it is $30 or higher depending on the characteristics of the plutonium and then for that extra year it is $30.

Q. $30 for all plutonium produced in domestic reactors? A. Yes.

Q. And regardless of quality? A. Regardless of characteristics.

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[3603]

By Mr. Sigal:

Q. Has AEC made it clear to PRDC that it cannot expect any specific price for plutonium after June 30, 1963? A. I believe I could say yes to that, that it is clear that we have not indicated to anyone—we can't, obviously, until we announce a new guaranteed price—what it will be.

Mr. Claytor: The record contains the statement, Mr. Examiner, on page six of Acker's supplemental testimony, that PRDC has no information or assurance as to what such price will be after June 30, 1963. There is no issue on that.

Mr. Sigal: Mr. Examiner, are we arguing the case now, or may I continue with my examination of Mr. Fields?

The Presiding Officer: You may continue.

By Mr Sigal:

Q. Mr. Fields, simply in corroboration of your own statement here, I would like to quote the statement you made to the joint committee in the authorization hearings,

[3604]

beginning at page 235, the bottom of the page, where you said, "We have no authority to guarantee prices beyond the time of seven years. Our presently announced schedule goes to July 1, 1963. It has been made very clear to all concerned, including the Power Reactor Development Company, that what happens after that is such to future determination." A. That is correct.

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[3614]

Q. That is perfectly clear, Mr. Fields.

Going back for a moment to the matter of

[3615]

the announcement of May 18, 1957, do you have the release before you? A. I have the public release, yes. I don't have the Federal Register publication.

Q. Well, I mean that release that you have there. It states at the bottom of the page that the Commission expects that the guaranteed fair price for plutonium will be reduced as dictated by consideration of the value of the material for its intended use by the United States, and giving such weight to the actual cost of producing it as the Commission finds to be equitable to a level based upon the fuel value of plutonium in commercial power reactors.

It would appear from this that even with respect to this announcement, this latest price schedule, that the objective is ultimately, according to the official position of AEC, to reduce the price for plutonium to a level based upon its

fuel value in commercial power reactors. Is that correct? A. I believe that is correct, yes.

Q. One thing with respect to this, however, that is not clear, is just when you will reduce it. A. That is correct.

Q. And this reduction may take place at any time after June 30, 1963? Is that correct? A. I would say at any time that the factors that

[3616]

dictate the determination of the fair price change. I presume the guarantee will change, yes.

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Cross Examination by Mr. Claytor

[3621]

By Mr. Claytor:

Q. General Fields, your estimate of the $12 fuel value of plutonium was based on a calculation of its use as a fuel in a thermal type of reactor, wasn't it? A. Yes, this is correct. The relative value of plutonium and Uranium-235 in a thermal reactor.

Q. And it might have a higher fuel value if used as a fuel in a fast reactor, might it not? A. I am not that technical an expert, but that is my understanding from a reactor physics point of view, that it could have a higher value, relative value, to Uranium-235.

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WALTER J. McCARTHY, JR. (recalled)

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[3870]

Direct Examination by Mr. Claytor

Q. Have you made any calculations to determine the relative worth of Uranium 235 and Plutonium 239 in a fast reactor?

Mr. Sigal: I object to that question.

Relative worth in what respect?

Now, if the question seeks a price, it is my impression that the witness is not qualified.

Mr. Claytor: Relative worth as a fuel. I thought the question indicated that. We are not asking about money. We are asking about fuel.

The Presiding Officer: He may not testify as to dollars. He may testify as to relative value, but not dollars.

Mr. Morrisson: The question seeks a physical quality. Is that right?

Mr. Claytor: Yes, the question seeks a physical quality.

The Witness: Yes. In a fast reactor of the size and neutron spectrum which is typified by the PRDC reactor in particular, the value of alpha for plutonium is such that the worth of plutonium, just as a sheer B. t. u. worth per gram put in, is about 60 percent higher than that of Uranium 235. This takes into account the decrease of the number of atoms in a gram. Obviously 235—239—This is as many atoms of plutonium in a gram as there are 235,

[3871]

and this is taken into account.

By Mr. Claytor:

Q. Since nuclear fuels are potential sources of heat, Mr. McCarthy, as are coal and other materials, is it possible to compare nuclear fuels, as used in a fast reactor, to such conventional fuels as coal based on an assumed value per heat unit of the conventional fuels?

My question asks is it possible to do this.

Mr. Sigal: I am sorry. That question escaped me. Will you please repeat it.

Mr. Claytor: Would you read my question, Mr. Reporter.

(The pending question was read by the reporter.)

Mr. Sigal: I still have to say I do not understand the question. If the witness understands it, I assume he will answer it.

The Witness: Yes, the witness understands it, Mr. Sigal. The question essentially means, since a gram of a fissionable fuel can be fissioned and make a certain amount of heat from that fission, and since a pound, say, of coal can be burned and can make a certain amount of heat from that pound of coal, how can you compare these on a dollar-per-B. t. u. basis. And you do this essentially by figuring out how many B. t. u. your get from a gram of plutonium or uranium should it fission. You can then, if you assume a

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price for B. t. u. and lots of B. t. u. are sold every day, and we know what they cost, then you can make

a ratio and find out how much the nuclear fuel is worth compared to the conventional fuel.

Now in an area such as Detroit coal in particular costs about 30 cents for every million B. t. u. of it you buy. That is the going price around there. This doesn't vary appreciably throughout the country. But in Detroit it is about 30 cents per million B. t. u.

Since a gram of plutonium, if burned in a fast reactor, makes about 65 million B.t.u., you can multiply the cents per million of the coal by the amount of millions you get in a reactor, and you come out with an equivalent cost, and this comes out to be about $21 per gram for plutonium as compared to coal as a heat source only. In other words, I could afford to pay $21 for plutonium in an area where coal costs 30 cents per million B.t.u. to get the same amount of physical heat.

By Mr. Clayton:

Q. Does that calculation assume that plutonium is being used as a fuel in a fast reactor, a thermal reactor? Or does it make a difference? A. It does make a difference. This particular calculation assumes it is made in a fast reactor. If it is made in a thermal reactor, a number of things happen. The

[3873]

principal one is this value alpha, the efficiency of burning, goes way down for plutonium in a thermal reactor. In particular Plutonium 239 captures neutrons without causing fission about one out of every three times. So this value alpha is .5 in this case.

* * *

The portions of the written narrative testimony, pages 3920-4401, designated by the parties are contained in Volume III of this joint appendix.

[4409]

Exhibit Acker 1-A

(PRDC-AEC REPROCESSING AGREEMENT)

UNITED STATES
ATOMIC ENERGY COMMISSION
CHICAGO OPERATIONS OFFICE
P. O. Box 59
Lemont, Illinois

March 25, 1957

Mr. Walker L. Cisler, President
Power Reactor Development Company
1100 Dime Building
Detroit 26, Michigan

Dear Mr. Cisler:

In furtherance of our program to demonstrate the practical value of nuclear power, the Commission and PRDC are ready to execute a contract, (designated as number AT(11-1)-476) under which PRDC will provide and operate an experimental nuclear power plant and the Commission will have conducted certain research and development work for the Project.

Much consideration has been given to the prices and arrangements under which spent fuel and blanket material from the reactor will be reprocessed. The Commission has now established policies in this area, which were published in the Federal Register (22 F.R. 1591) on March 12, 1957. Based upon and subject to the above-mentioned policies, which are incorporated herein by reference, the following charges are established:

A. *Reprocessing Services*

If requested to do so by the Company, the Commission will accept material for the purpose of furnishing the services specified below:

1. *Core Subassemblies*

b. The Commission will disassemble as necessary the irradiated core subassemblies.

b. The Commission will separate and recover uranium and plutonium from irradiated core subassemblies,

[4410]

converting such uranium and plutonium to decontaminated uranium nitrate and plutonium nitrate respectively.

c. The Commission will dispose of all wastes resulting from the above steps.

2. *Blanket Subassembly Reprocessing*

a. The Commission will disassemble as necessary the irradiated subassemblies.

b. The Commission will separate out and recover uranium and plutonium from irradiated blanket subassemblies, converting such uranium and plutonium to decontaminated uranium nitrate and plutonium nitrate respectively.

c. The Commission will dispose of all wastes resulting from the above steps.

3. *Disposition of Depleted Uranium Nitrate*

The Commission will store depleted uranium nitrate resulting from reprocessing blanket materials or

return the depleted uranium nitrate to the Company, at the Company's option.

4. *Conversion of Enriched Uranium Nitrate to UF_6*
The Commission will convert the enriched uranium nitrate to UF_6.

5. *Conversion of Plutonium Nitrate to Metal*
The Commission will convert plutonium nitrate to metal.

B. *Schedule of Charges*

1. For the services set forth in subsection A. 1. above, the Company will pay the Commission on the basis of the daily cost of $15,300.00 and a daily throughput of 150 kilograms of contained uranium.

[4411]

2. For the services to be performed under Subsection A. 2. above, the Company will pay the Commission on the basis of the daily cost of $15,300.00 and a daily throughput of 1,000 kilograms of contained uranium.
3. For storing depleted uranium nitrate, the Company will pay the Commission the costs of the storage containers.
4. For the services to be performed under Subsection A. 4. above, the Company will pay the Commission an amount established by the Commission but not exceeding $35.00 per kilogram of contained uranium.
5. For the services to be performed under Subsection A. 5. above, the Company will pay the Commission the charges set forth in Exhibit A to this letter.

6. The charges set forth in B. 1. and 2. above do not include an allowance for "turn around" time at the processing facilities. Therefore, an additional charge to cover this item will be made in accordance with subsection 6. (d) of the policy statement set forth in 22 F. R. 1591.
7. An additional charge to cover process losses will be made at the rate of 1 percent of the value of the government-owned source or special nuclear materials to be processed. Unless waived by the AEC, a use charge on leased source and special nuclear material will also be made to cover the normal processing time after delivery of fuel to the AEC.
8. Persons who have contracted with the AEC for these processing services will be credited with the value of government-owned source and special nuclear material contained in the fuel in accordance with the appropriate AEC price schedules for such materials, less the processing charges as determined in the above manner. The AEC will acquire title, without additional cost, to all waste materials contained in the fuel which were not previously the property of the United States.
9. The above charges are all F. O. B. the Commission plant.

[4412]

Changes

It is recognized that these charges are based on information covering the designs of the core and blanket

subassemblies and the batch sizes returned for processing which was furnished with the letter of June 4, 1956, from R. W. Hartwell to C. G. Manley, and that the designs and batch sizes are subject to change. Any change in the design may affect the flow rates specified in B. 1. and 2. above and may also result in an appropriate change in the daily processing charge for services as set forth in this letter.

It is understood that PRDC and the Commission will, within the next six months, negotiate a formal agreement superseding this letter and covering reprocessing arrangements, such agreement not to be inconsistent with the foregoing Commission policies and to contain prices no higher than those provided in B. In the event such formal agreement is not completed within six months, or such other time as may be mutually agreed upon, either party may terminate this agreement.

In addition, it is understood that any more favorable terms or conditions than those set forth above which are adopted by the Commission in the future for general application and for comparable services will be extended to the company.

If the foregoing is acceptable to PRDC, please so indicate by approving two copies of this letter and return them to me.

Very truly yours

J. J. FLAHERTY
J. J. FLAHERTY
Manager

Enclosure:
Exhibit A. (Sep. cov.)

Accepted this 26 day of March, 1957
WALKER L. CISLER
Walker L. Cisler, President
Power Reactor Development Company

[4413]

Exhibit Acker 1-B

(EXHIBIT A TO PRDC-AEC REPROCESSING AGREEMENT)

[CONFIDENTIAL]
UNCLASSIFIED

EXHIBIT A to LETTER DATED MARCH 25, 1957, FROM J. J. FLAHERTY, MANAGER, CHICAGO OPERATIONS OFFICE, U. S. ATOMIC ENERGY COMMISSION, TO WALKER L. CISLER, PRESIDENT, POWER REACTOR DEVELOPMENT COMPANY

For the services to be performed under Subsection A. 5 of the above-referenced letter, the Company will pay the Commission the charge of $1.50 per gram of contained plutonium.

J. F.
MC

CLASSIFICATION CANCELLED
Name: rm
Date: 5-10-57

[RESTRICTED DATA]

[This document contains restricted data as defined in the Atomic Energy Act of 1954. Its trans-

mittal or disclosure of its contents in any manner to an unauthorized person is prohibited.]

[CONFIDENTIAL]
UNCLASSIFIED

[Matter enclosed between brackets cancelled in copy]

[4414]

Exhibit Acker 2

(SEE ALSO LATER EXHIBIT, APPLICATION EXHIBIT XLIV, Tr. pp. 6070-78.)

POWER REACTOR DEVELOPMENT COMPANY
ENRICO FERMI ATOMIC POWER PLANT PROJECT

STATEMENT OF SOURCE AND APPLICATION OF CASH DURING PERIOD OF OPERATIONS

Arthur Andersen & Co.
Detroit

February 27, 1957.

[4415]

POWER REACTOR DEVELOPMENT COMPANY
ENRICO FERMI ATOMIC POWER PLANT PROJECT

STATEMENT OF SOURCE AND APPLICATION OF CASH DURING PERIOD OF OPERATIONS

At the request of the Company, statements showing the source and application of cash during the period of prospective operations, which period covers the years 1961

through 1970, were prepared based upon data furnished by Company personnel as of December 31, 1956. The attached statements represent revision of the statements of December 31, 1956, based upon data available as of February 27, 1957.

Power Reactor Development Company has received an opinion from its tax counsel, Mr. Roswell Magill, that it is exempt from Federal income taxation as a nonprofit scientific institution under Section 501 of the Internal Revenue Code of 1954. A request for ruling that it is such a tax-exempt organization is now pending before the Internal Revenue Service. Schedule 1 is a statement of source and application for cash during the period of operations on the assumption that the Company will not be subject to Federal income tax liability during this period.

The Company has considered the possibility that, contrary to the opinion of its tax counsel, favorable action will not be received on its pending request for ruling that it is exempt from Federal income taxation as a nonprofit scientific institution. In the event that the Company's request for ruling that it is exempt from Federal income tax is denied, the Company's tax counsel has prepared and now has pending before the Internal Revenue Service a request for ruling to determine whether or not the contributions of its members are taxable income to the Company.

[4416]

Schedule 2, showing source and application of cash during the period of operations, is based on the assumption that there will be Federal income tax liability but that the contributions from members will not be taxable income

to the Company. Schedule 3, showing source and application of cash during the period of operations, is based on the assumption that there will be Federal income tax liability and that the contributions from members will be taxable income to the Company.

Cash sources and cash applications for the period of operations are based upon data furnished by Company personnel. Cash balance at the beginning of 1961 is a carry-forward from the statements of source and application of cash during the construction period.

In determining the Federal income tax liability shown on Schedules 2 and 3, the cash sources and cash applications for the period of operations as furnished by Company personnel were adjusted to reflect depreciation expense.

In computing the Federal income tax liability assuming that contributions from members are not taxable income to the Company which appears on Schedule 2, the tax basis of the plant for depreciation purposes is decreased in an amount equal to the contributions. This adjustment represents conservative tax accounting for money contributed to a corporation for plant construction.

Tax counsel for the Company has given an opinion that the cost of the plant (exclusive of the estimated site improvement costs) in excess of the cost of conventional facilities may be considered as research and development expense. The tax basis of the plant for

[4417]

depreciation purposes is adjusted to reflect this treatment in computing the Federal tax liability assuming that con-

tributions from members are taxable income which appears on Schedule 3. Cost of a conventional steam plant of the same capacity is estimated by Company engineers to be approximately $13,200,000.

The Company engineers furnished the estimated life of the plant and net salvage.

STATEMENT OF SOURCE AND APPLICATION OF CASH

DURING TEN YEAR OPERATING PERIOD

ASSUMING THAT COMPANY HAS NO FEDERAL INCOME TAX LIABILITY

Particulars	Line No.	Year 1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	Total
Source of cash-												
Operating revenues-												
Steam sales	1	$ 1,191,000	$1,537,000	$3,878,000	$3,649,000	$ 4,644,000	$ 5,332,000	$ 5,182,000	$ 5,867,000	$ 6,015,000	$ 6,165,000	$43,460,
Sales of plutonium	2	1,383,000	1,864,000	2,987,000	4,076,000	5,526,000	6,228,000	6,313,000	6,497,000	6,888,000	6,861,000	48,623,
Temporary bank loans	3	287,700	1,986,800	-	1,162,400	-	-	-	-	-	-	3,436,
	4	$ 2,861,700	$5,387,800	$6,865,000	$8,887,400	$10,170,000	$11,566,000	$11,495,000	$12,364,000	$12,903,000	$13,026,000	$95,525,
Application of cash-												
Operating expenses-												
Production costs	5	$ 1,472,700	$1,536,300	$1,801,900	$1,831,500	$ 1,977,200	$ 2,063,800	$ 2,052,500	$ 2,180,200	$ 2,217,200	$ 2,259,600	$19,390,
Core processing costs	6	778,000	742,000	757,000	849,000	840,000	782,000	725,000	749,000	794,000	795,000	7,811,
Blanket processing costs	7	235,000	261,000	345,000	431,000	556,000	717,000	713,000	728,000	762,000	761,000	5,509,
Additional fuel cycle costs	8	1,202,000	1,294,000	1,832,000	2,237,000	3,216,000	3,396,000	3,361,000	3,532,000	3,677,000	3,677,000	27,424,
Property taxes	9	690,000	690,000	690,000	690,000	690,000	690,000	690,000	690,000	690,000	690,000	6,900,
Insurance	10	149,000	149,000	149,000	149,000	149,000	149,000	149,000	149,000	149,000	149,000	1,490,
Interest on long-term bank loans	11	652,000	653,000	652,000	587,000	500,000	414,000	326,000	239,000	153,000	33,000	4,209,
Interest on temporary bank loans	12	77,000	62,500	97,800	112,900	138,800	105,800	40,300	200	-	-	565,
Payment of principal on long-term bank loans	13	-	-	-	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	3,000,000	15,000,
Payment of principal on temporary bank loans	14	-	-	540,300	-	103,000	1,248,400	1,438,200	107,000	-	-	3,436,
	15	$ 5,185,700	$5,387,800	$6,865,000	$8,887,400	$10,170,000	$11,566,000	$11,495,000	$10,374,400	$10,440,200	$11,362,600	$91,736,
Net cash increase (decrease) during year	16	$(2,324,000)	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,989,600	$ 2,462,800	$ 1,663,400	$ 3,789,
Cash balance - beginning of 1961	17	$ 3,499,000										
Cash balance - end of year	18	$ 1,175,000	$1,175,000	$1,175,000	$1,175,000	$ 1,175,000	$ 1,175,000	$ 1,175,000	$ 3,164,600	$ 5,627,400	$ 7,288,800	$ 7,288,

[4419]

SCHEDULE NO. 9

STATEMENT OF SOURCE AND APPLICATION OF CASH
DURING TEN YEAR OPERATING PERIOD
ASSUMING THAT COMPANY HAS FEDERAL INCOME TAX LIABILITY
AND THAT CONTRIBUTIONS ARE NOT TAXABLE INCOME

Particulars	Line No.	Year 1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	Total
Source of cash-												
Operating revenues-												
Steam sales	1	$ 1,191,000	$1,537,000	$3,878,000	$3,649,000	$ 4,644,000	$ 5,338,000	$ 5,182,000	$ 5,867,000	$ 6,015,000	$ 6,165,000	$43,466,000
Sales of plutonium	2	1,383,000	1,864,000	2,987,000	4,076,000	5,526,000	6,228,000	6,313,000	6,497,000	6,888,000	6,861,000	48,623,000
Temporary bank loans	3	287,700	1,986,800	-	1,162,400	-	-	-	-	-	-	3,436,900
	4	$ 2,861,700	$5,387,800	$6,865,000	$8,887,400	$10,170,000	$11,566,000	$11,495,000	$12,364,000	$12,903,000	$13,026,000	$95,525,900
Application of cash-												
Operating expenses-												
Production costs	5	$ 1,472,700	$1,536,300	$1,801,900	$1,831,500	$ 1,977,200	$ 2,063,800	$ 2,052,500	$ 2,180,200	$ 2,217,200	$ 2,257,600	$19,390,900
Core processing costs	6	778,000	742,000	757,000	849,000	840,000	782,000	725,000	749,000	794,000	795,000	7,811,000
Blanket processing costs	7	235,000	261,000	345,000	431,000	556,000	717,000	713,000	728,000	762,000	761,000	5,509,000
Additional fuel cycle costs	8	1,202,000	1,294,000	1,832,000	2,237,000	3,216,000	3,396,000	3,361,000	3,532,000	3,677,000	3,677,000	27,424,000
Property taxes	9	690,000	690,000	690,000	690,000	690,000	690,000	690,000	690,000	690,000	690,000	6,900,000
Insurance	10	149,000	149,000	149,000	149,000	149,000	149,000	149,000	149,000	149,000	149,000	1,490,000
Interest on long-term bank loans	11	652,000	653,000	652,000	587,000	500,000	414,000	326,000	239,000	153,000	33,000	4,209,000
Interest on temporary bank loans	12	7,000	62,500	97,800	112,900	138,800	105,800	40,300	200	-	-	565,300
Payment of principal on long-term bank loans	13	-	-	-	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	3,000,000	15,000,000
Payment of principal on temporary bank loans	14	-	-	540,300	-	103,000	1,248,400	1,438,200	107,000	-	-	3,436,900
Federal income tax payments (see Schedule No. 4)	15	-	-	-	-	-	-	-	273,600	1,381,600	2,729,400	4,384,600
	16	$ 5,185,700	$5,387,800	$6,865,000	$8,887,400	$10,170,000	$11,566,000	$11,495,000	$10,848,000	$11,823,800	$14,092,000	$96,320,700
Net cash increase (decrease) during year	17	$(2,324,000)	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,516,000	$ 1,079,200	$(1,066,000)	$ (794,800)
Cash balance - beginning of 1961	18	$ 3,499,000										
Cash balance - end of year	19	$ 1,175,000	$1,175,000	$1,175,000	$1,175,000	$ 1,175,000	$ 1,175,000	$ 1,175,000	$ 2,691,000	$ 3,770,200	$ 2,704,200	$ 2,704,200

SCHEDULE NO. 3

[4420]

STATEMENT OF SOURCE AND APPLICATION OF CASH

DURING TEN YEAR OPERATING PERIOD

ASSUMING THAT COMPANY HAS FEDERAL INCOME TAX LIABILITY

AND THAT CONTRIBUTIONS ARE TAXABLE INCOME

Particulars	Line No.	Year 1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	Total
Source of cash												
Operating revenues-												
Steam sales	1	$ 1,191,000	$ 1,537,000	$3,878,000	$3,649,000	$ 4,644,000	$ 5,338,000	$ 5,182,000	$ 5,867,000	$ 6,015,000	$ 6,165,000	$43,466,000
Sales of plutonium	2	1,383,000	1,864,000	2,987,000	4,076,000	5,526,000	6,228,000	6,313,000	6,497,000	6,888,000	6,861,000	48,623,000
Temporary bank loans	3	1,421,600	909,600	-	1,165,400	-	-	-	-	-	-	3,496,600
	4	$ 3,995,600	$ 4,310,600	$6,865,000	$8,890,400	$10,170,000	$11,566,000	$11,495,000	$12,364,000	$12,903,000	$13,026,000	$95,585,600
Application of cash-												
Operating expenses-												
Production costs	5	$ 1,472,700	$ 1,536,300	$1,801,900	$1,831,500	$ 1,977,200	$ 2,063,800	$ 2,052,500	$ 2,180,200	$ 2,217,200	$ 2,257,600	$19,390,900
Core processing costs	6	778,000	742,000	757,000	849,000	840,000	782,000	725,000	749,000	794,000	795,000	7,811,000
Blanket processing costs	7	235,000	261,000	345,000	431,000	556,000	717,000	713,000	728,000	762,000	761,000	5,509,000
Additional fuel cycle costs	8	1,202,000	1,294,000	1,832,000	2,237,000	3,216,000	3,396,000	3,361,000	3,532,000	3,677,000	3,677,000	27,424,000
Property taxes	9	690,000	690,000	690,000	690,000	690,000	690,000	690,000	690,000	690,000	690,000	6,900,000
Insurance	10	149,000	149,000	149,000	149,000	149,000	149,000	149,000	149,000	149,000	149,000	1,490,000
Interest on long-term bank loans	11	652,000	653,000	652,000	587,000	500,000	414,000	326,000	239,000	153,000	33,000	4,209,000
Interest on temporary bank loans	12	34,700	91,500	100,600	115,900	141,900	109,100	43,700	700	-	-	638,100
Payment of principal on long-term bank loans	13	-	-	-	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	3,000,000	15,000,000
Payment of principal on temporary bank loans	14	-	-	537,500	-	99,900	1,245,100	1,434,800	179,300	-	-	3,496,600
Federal income tax payments (refunds) (see Schedule No. 6)	15	603,100	(1,106,200)	-	-	-	-	-	305,200	1,157,600	2,562,600	3,522,300
	16	$ 5,816,500	$ 4,310,600	$6,865,000	$8,890,400	$10,170,000	$11,566,000	$11,495,000	$10,752,400	$11,599,800	$13,925,200	$95,390,900
Net cash increase (decrease) during year	17	$(1,820,900)	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,611,600	$ 1,303,200	$ (899,200)	$ (194,700)
Cash balance - beginning of 1961	18	$ 2,995,900										
Cash balance - end of year	19	$ 1,175,000	$ 1,175,000	$1,175,000	$1,175,000	$ 1,175,000	$ 1,175,000	$ 1,175,000	$ 2,786,600	$ 4,089,800	$ 3,190,600	$ 3,190,600

CALCULATION OF FEDERAL INCOME TAX PAYMENTS DURING OPERATING PERIOD

ASSUMING THAT CONTRIBUTIONS ARE NOT TAXABLE INCOME

	Line No.	Year 1961	1962	1963	1964	1965	1966	1967	1968	1969	1970 (see Note)	Total
	1	$ 1,191,000	$ 1,537,000	$3,878,000	$3,649,000	$ 4,644,000	$ 5,338,000	$ 5,182,000	$ 5,867,000	$ 6,015,000	$ 6,165,000	$43,466,000
	2	1,383,000	1,864,000	2,987,000	4,076,000	5,526,000	6,228,000	6,313,000	6,497,000	6,888,000	6,861,000	48,623,000
g revenues	3	$ 2,574,000	$ 3,401,000	$6,865,000	$7,725,000	$10,170,000	$11,566,000	$11,495,000	$12,364,000	$12,903,000	$13,026,000	$92,089,000
	4	$ 1,472,700	$ 1,536,300	$1,801,900	$1,831,500	$ 1,977,200	$ 2,063,800	$ 2,052,500	$ 2,180,200	$ 2,217,200	$ 2,257,600	$19,390,900
	5	778,000	742,000	757,000	849,000	840,000	782,000	725,000	749,000	794,000	795,000	7,811,000
ts	6	235,000	261,000	345,000	431,000	556,000	717,000	713,000	728,000	762,000	761,000	5,509,000
costs	7	1,202,000	1,294,000	1,832,000	2,237,000	3,216,000	3,396,000	3,361,000	3,532,000	3,677,000	3,677,000	27,424,000
	8	690,000	690,000	690,000	690,000	690,000	690,000	690,000	690,000	690,000	690,000	6,900,000
	9	149,000	149,000	149,000	149,000	149,000	149,000	149,000	149,000	149,000	149,000	1,490,000
bank loans	10	652,000	653,000	652,000	587,000	500,000	414,000	326,000	239,000	153,000	33,000	4,209,400
bank loans	11	7,000	62,500	97,800	112,900	138,800	105,800	40,300	200	-	-	565,300
dule No. 5)	12	650,100	650,100	650,100	650,100	650,100	650,100	650,100	650,100	650,100	650,100	6,501,000
research and	13	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	5,000,000
	14	$ 6,335,800	$ 6,537,900	$7,474,800	$8,037,500	$ 9,217,100	$ 9,467,700	$ 9,206,900	$ 9,417,500	$ 9,592,400	$ 9,512,700	$84,800,200
)	15	$(3,761,800)	$(3,136,900)	$ (609,800)	$ (312,500)	$ 952,900	$ 2,098,300	$ 2,288,100	$ 2,946,500	$ 3,310,700	$ 3,513,300	$ 7,288,800
lity	16	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,047,100	$ 1,716,100	$ 1,821,400	$ 4,584,600
nts	17	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 473,600	$ 1,381,600	$ 2,729,400	$ 4,584,600

NOTE: The Federal income tax payment for 1970 includes the entire liability applicable to that year although $960,700 is not due until 1971.

SCHEDULE NO. 5

CALCULATION OF ANNUAL DEPRECIATION ASSUMING THAT CONTRIBUTIONS ARE NOT TAXABLE INCOME

Plant expenditures (see Exhibit XXVIII, Schedule No. 4, Line No. 1)	$28,225,000
Add—Administration expense (see Exhibit XXVIII, Schedule No. 4, Line No. 4)	1,816,000
Total plant	$30,041,000
Less—Contributions (see Exhibit XXVII, Schedule No. 1, Line No. 1)	23,540,000
Net depreciable plant—adjusted basis	$ 6,501,000
Annual depreciation—based on ten year life and assuming that salvage will be equal to cost of removal	$ 1,363,890

CALCULATION OF FEDERAL INCOME TAX PAYMENTS DURING OPERATING PERIOD

ASSUMING THAT CONTRIBUTIONS ARE TAXABLE INCOME

Particulars	Line No.	Year 1961	1962	1963	1964	1965	1966	1967	1968	1969	1970 (see Note)	Total
erating revenues-												
Steam sales	1	$ 1,191,000	$ 1,537,000	$3,878,000	$3,649,000	$ 4,644,000	$ 5,338,000	$ 5,182,000	$ 5,867,000	$ 6,015,000	$ 6,165,000	$43,466,000
Sales of plutonium	2	1,383,000	1,864,000	2,987,000	4,076,000	5,526,000	6,228,000	6,313,000	6,497,000	6,888,000	6,861,000	48,623,000
Total operating revenues	3	$ 2,574,000	$ 3,401,000	$6,865,000	$7,725,000	$10,170,000	$11,566,000	$11,495,000	$12,364,000	$12,903,000	$13,026,000	$92,089,000
penses:												
Production costs	4	$ 1,472,700	$ 1,536,300	$1,801,900	$1,831,500	$ 1,977,200	$ 2,083,800	$ 2,052,500	$ 2,180,200	$ 2,217,200	$ 2,257,600	$19,330,900
Core processing costs	5	778,000	742,000	757,000	849,000	840,000	782,000	725,000	749,000	794,000	795,000	7,811,000
Blanket processing costs	6	235,000	261,000	345,000	431,000	556,000	717,000	713,000	728,000	762,000	761,000	5,509,000
Additional fuel cycle costs	7	1,202,000	1,294,000	1,832,000	2,237,000	3,216,000	3,396,000	3,361,000	3,532,000	3,677,000	3,677,000	27,424,000
Property taxes	8	690,000	690,000	690,000	690,000	690,000	690,000	690,000	690,000	690,000	690,000	6,900,000
Insurance	9	149,000	149,000	149,000	149,000	149,000	149,000	149,000	149,000	149,000	149,000	1,490,000
Interest on long-term bank loans	10	652,000	653,000	652,000	587,000	500,000	414,000	326,000	239,000	153,000	93,000	4,269,000
Interest on temporary bank loans	11	34,700	91,500	100,600	115,900	141,900	109,100	43,700	700	-	-	638,100
Depreciation (see Schedule No. 7)	12	1,363,890	1,363,890	1,363,890	1,363,890	1,363,890	1,363,890	1,363,890	1,363,890	1,363,890	1,363,890	13,638,900
Total expenses	13	$ 6,577,290	$ 6,780,690	$7,691,390	$8,254,290	$ 9,433,990	$ 9,684,790	$ 9,424,090	$ 9,631,790	$ 9,806,090	$ 9,796,490	$87,010,900
t taxable income (loss)	14	$(4,003,290)	$(3,379,690)	$ (826,390)	$ (529,290)	$ 736,010	$ 1,881,210	$ 2,070,910	$ 2,732,210	$ 3,096,910	$ 3,299,510	$ 5,078,100
deral income tax liability	15	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 710,300	$ 1,604,900	$ 1,710,200	$ 4,025,400
deral income tax payments (refunds)	16	$ 603,100	$(1,106,200)	$ -	$ -	$ -	$ -	$ -	$ 305,200	$ 1,157,600	$ 2,562,600	$ 3,522,300

NOTE: The Federal income tax payment for 1970 includes the entire liability applicable to that year although $905,100 is not due until 1971.

SCHEDULE NO. 7

CALCULATION OF ANNUAL DEPRECIATION ASSUMING THAT CONTRIBUTIONS ARE NOT TAXABLE INCOME

Plant expenditures (see Exhibit XXVIII, Schedule No. 4, Line No. 5)	$27,721,800
Less—Portion of plant expenditures considered research and development cost (see Exhibit XXVIII, Schedule No. 4, Line No. 8)	14,082,900
Total depreciable plant	$13,638,900
Annual depreciation—based on ten year life and assuming that salvage will be equal to cost of removal	$ 1,363,890

[4449]

Exhibit Acker 6

SUMMARY OF REACTOR PLANT EQUIPMENT AND DEVICES TO BE PURCHASED AND INSTALLED BY APDA FOR TESTING AND TO BE TRANSFERRED TO PRDC AT SALVAGE VALUE AFTER TEST.

		*Est. Material Cost**	*Est. Installation Labor**	*Total*	*Contingencies**
C-2	Reactor Vessel	$1,062,300	$ 82,500	$1,144,800	$171,600
C-3	Rotating Plug & Drive	456,350	50,000	506,350	75,950
C-1	Primary Shield Tank	120,000	-0-	120,000	18,000
B-3	Hold Down Mechanism	167,500	101,500	269,000	26,900
C-4	Two Control Rods	38,000	-0-	38,000	5,700
C-5	Two Control Rod Actuators	56,300	-0-	56,300	8,400
C-8	Offset Element Handling Mech.	225,500	60,000	285,500	42,800
C-10	Element Transfer Rotor & Drive	115,000	35,000	150,000	22,500
D-1	Sodium Pump	146,000	10,000	156,000	46,800
D-1	Check Valve	7,700	2,000	9,700	2,900
D-5	Primary System Piping	55,000	21,000	76,000	22,700
D-6	6" Blanket Flow Valve	10,000	1,000	11,000	3,300
G-6	Reactor Plant Instruments	52,500	-0-	52,500	22,500
G-10	Accessory Electric Equipment	70,000	-0-	70,000	30,000
H-4	Initial Operating Supplies	100,000	5,000	105,000	31,500
J	Const. Plant Equip. & Tools	400,000	-0-	400,000	-0-
	Engineering	-0-	150,000	150,000	-0-
		$3,082,150	$518,000	$3,600,150	$531,550

* Estimated Material and Labor Costs, including allowance for contingencies, derived from PRDC construction estimate, Exhibit XXVII to PRDC Application for License.

[4451]

Exhibit Acker 7

(PRDC CONSTRUCTION COST ESTIMATES)

PRDC ENRICO FERMI ATOMIC POWER PLANT PROJECT SUMMARY CONSTRUCTION ESTIMATE

	Material & Labor	*Contingencies*	*Total*
General fill and site improvements	$ 399,000		$ 399,000
Contingencies at 10%		$ 39,900	39,900
Reactor plant structures	4,572,875		4,572,875
Contingencies at 10%		457,325	457,325
Reactor plant equipment	5,647,450		5,647,450
Contingencies at 15%		847,250	847,250
Primary system Na to Na	2,008,000		2,008,000
Contingencies at 30%		612,000	612,000
Secondary system Na to water	1,318,000		1,318,000
Contingencies at 30%		395,000	395,000
Liquid metal storage	533,000		533,000
Contingencies at 30%		159,000	159,000
Other reactor plant equipment and facilities	3,391,000		3,391,000
Contingencies at 30%		1,017,000	1,017,000
Initial operating supplies	1,061,000		1,061,000
Contingencies at 30%		317,000	317,000
Miscellaneous reactor plant equipment and facilities	604,000		604,000
Contingencies at 15%		90,000	90,000
Total Material, Labor & Contingencies	$19,534,325	$3,934,475	$23,468,800
Construction plant, equipment rental, tools and fee			$ 2,977,000
Spare parts, control rods, rod actuators, core and blanket elements			160,000
Preoperation testing after construction			350,000

Personnel training	500,000
Initial operation low to full load	550,000
Interest during construction	1,800,000
Engineering services and expenses	900,000
Local taxes, etc.	519,200
Working capital	1,175,000
Total Estimated Plant Cost	$32,400,000

[4452]

PRDC ENRICO FERMI ATOMIC POWER PLANT PROJECT

SUMMARY OF ESCALATION ALLOWANCE FOR MAJOR EQUIPMENT

	Escalation Allowance Included In Estimate
Primary shield tank	$ 10,000
Reactor vessel including steel shielding, internal structures and heating system	91,500
Rotating plug including shield disks, index system, controls, drives, Nak and gas seals	50,000
Control rods including fast neutron poison	24,200
Control rod actuators	41,900
Offset element handling mechanism	35,000
Element transfer rotor and drive	20,000
Containment vessel	56,000
Total Escalation Allowance	$328,600

Plant Material and Labor less Escalation Allowance	$19,205,725	
Escalation Allowance	328,600	
Contingencies	3,934,475	
Subtotal		$23,468,800

Total construction plant, spare parts, preoperation testing, personnel training initial operation, interest, engineering, taxes and working capital ..	8,931,200
Total Estimated Plant Cost ...	$32,400,000

Note: On equipment not purchased an allowance for escalation is included as a part of the estimated price.

[4453]

Exhibit XXVII

PRDC ENRICO FERMI ATOMIC POWER PLANT PROJECT CONSTRUCTION ESTIMATE

Description	*Material*	*Labor*	*Total*
Structures and Improvements			
General Fill			
1. Dredge and grade fill on site		$ 135,000	$ 135,000
2. Riprap	$ 12,000	17,000	29,000
Site Improvements			
3. Finish grading and gravel	9,000	6,000	15,000
4. Roads and parking area	20,000	45,000	65,000
5. Railroad track	18,000	22,000	40,000
6. Yard piping all services	18,000	27,000	45,000
7. Storm sewers, drains and catch basins	10,000	20,000	30,000
8. Yard lighting	5,000	10,000	15,000
9. Fencing	6,000	4,000	10,000
10. Landscaping	5,000	10,000	15,000
Total Material and Labor	$ 103,000	$ 296,000	$ 399,000
Contingencies	10,300	29,600	39,900
Total	$ 113,300	$ 325,600	$ 438,900

B—*Reactor Plant Structures*

1. Reactor containment vessel excavation foundations and external concrete work	$ 228,400	$ 242,600	$ 471,000
2. Containment vessel	735,250		735,250
3. Internal structural and concrete work and equipment decay tanks	841,525	511,490	1,353,015
4. Element decay and storage structure	228,585	199,865	428,450
5. Repair shop and shipping	86,365	54,795	141,160
6. Office building	125,000	150,000	275,000
7. Boiler rooms	95,000	125,000	220,000
8. Service building	200,000	200,000	400,000
9. Hot cave building	15,000	20,000	35,000
10. Sodium storage and inert gas building	110,000	115,000	225,000
11. Control room relay and switch-gear rooms	35,000	45,000	80,000
12. Electrical equipment room	35,000	48,000	83,000
13. Connecting passageways between buildings	7,000	9,000	16,000

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[4454]

Description	*Material*	*Labor*	*Total*
Reactor Plant Structures (Contd)			
14. Stack	$ 75,000	$ 10,000	$ 85,000
15. Fan rooms and stack	15,000	10,000	25,000
Total Material and Labor	$ 2,832,125	$1,740,000	$ 4,572,875
Contingencies	283,275	174,050	457,325
Total	$ 3,115,400	$1,914,800	$ 5,030,200

—*Reactor Plant Equipment*

1. Primary shield tank including steel and graphite shielding gas cooling system and reactor vessel supports	$ 382,500	$ 95,000	$ 477,500
2. Reactor vessel including steel shielding internal structures, heating system	1,107,300	87,500	1,194,800
3. Rotating plug including shield disks, index system, controls, drives, Nak and gas seals	556,350	70,000	626,350
4. Control rods including fast neutron poison	213,800	15,000	228,800
5. Control rod actuators	282,100	25,000	307,100
6. Ionization chambers	30,000	6,000	36,000
7. Overhead crane with gripper 150 t, and auxiliary 25 t, remote control from operating floor	175,000	25,000	200,000
8. Offset element handling mechanism	266,900	60,000	326,900
9. Element memory system	220,000	80,000	300,000
10. Element transfer rotor and drive	125,000	35,000	160,000
11. Element transfer cask and car	400,000	10,000	410,000
12. Element transfer and cleanup	200,000	40,000	240,000
13. Underwarter hydraulic opr cart	80,000	20,000	100,000
14. Decay storage racks	550,000	130,000	680,000
15. Decay building gas and water systems and disassembly machinery	290,000	70,000	360,000
Total Material and Labor	$ 4,878,950	$ 768,500	$ 5,647,450
Contingencies	731,750	115,500	847,250
Total	$ 5,610,700	$ 884,000	$ 6,494,700

Liquid Metal System

D—*Primary System Na to Na*			
1. Sodium pumps including sump tanks and drives and heating	$ 480,000	$ 40,000	$ 520,000

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[4455]

Description	*Material*	*Labor*	*Total*
Primary System Na to Na (Contd)			
2. Pump tank insulation	$ 15,000	$	$ 15,000
3. Intermediate heat exchanger	925,000	30,000	955,000
4. Heat exchanger insulation	15,000		15,000
5. Main loop piping including blanket flow and overflow piping with supports	165,000	65,000	230,000
6. 6" blanket flow control valves (bellows seal)	30,000	3,000	33,000
7. Secondary containment and leak detection system	50,000	20,000	70,000
8. Pipe insulation including boron carbide covering	20,000		20,000
9. Overflow tank	20,000	5,000	25,000
10. Overflow pumps and motors	100,000	25,000	125,000
Total Material and Labor	$ 1,820,000	$ 188,000	$ 2,008,000
Contingencies	546,000	66,000	612,000
Total	$ 2,336,000	$ 254,000	$ 2,620,000
E—*Secondary System Na to Water*			
1. Steam generators	$ 600,000	$ 50,000	$ 650,000
2. Steam generator insulation	20,000		20,000

3. Steam generator supports	3,000	1,500	4,500
4. Sodium pumps and drives	390,000	15,000	405,000
5. Pump insulation	7,000		7,000
6. Pump supports	3,000	1,500	4,500
7. Main loop piping, supply and return including supports	102,000	30,000	132,000
8. Pipe heating and controls	14,000	6,000	20,000
9. Secondary containment and leak detection system	40,000	20,000	60,000
10. Pipe insulation	15,000		15,000
Total Material and Labor	$ 1,194,000	$ 124,000	$ 1,318,000
Contingencies	358,000	37,000	395,000
Total	$ 1,552,000	$ 161,000	$ 1,713,000

F—*Liquid Metal Storage*

1. Storage tanks, three 15,000 gal, three 6000 gal	$ 150,000	$ 30,000	$ 180,000
2. Tank heating	60,000	30,000	90,000
3. Tank supports	8,000	5,000	13,000
4. Unloading and purification system including Nak cooling	200,000	50,000	250,000
Total Material and Labor	$ 418,000	$ 115,000	$ 533,000

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[4456]

Description	*Material*	*Labor*	*Total*
Contingencies	$ 125,000	$ 34,000	$ 159,000
Total	$ 543,000	$ 149,000	$ 692,000

G. *Other Reactor Plant Equipment and Facilities*

1. Hot cave structure and equipment	208,000	56,000	264,000

2. Conventional physics and chemical laboratory equipment	145,000	5,000	150,000
3. Health physics instruments and equipment	160,000	40,000	200,000
4. Health physics wiring and conduit	15,000	60,000	75,000
5. Inert gas system including vent gas system	170,000	80,000	250,000
6. Reactor plant instrumentation and control boards	700,000	150,000	850,000
7. Instrument wiring and tubing	100,000	100,000	200,000
8. Steam and feedwater piping from steam generator outlet to steam generator enclosure wall	150,000	80,000	230,000
9. Steam generator instrumentation including control air compressor, tubing etc.	40,000	60,000	100,000
10. Accessory electric equipment	616,000	291,000	907,000
11. Emergency power supply equipment	150,000	15,000	165,000
Total Material and Labor	$ 2,454,000	$ 937,000	$ 3,391,000
Contingencies	736,000	281,000	1,017,000
Total	$ 3,190,000	$1,218,000	$ 4,408,000
H. *Initial Operating Supplies*			
1. Neutron source	18,000	2,000	20,000
2. Initial core elements	233,000	23,000	256,000
3. Initial blanket elements	377,000	143,000	520,000
4. Initial sodium, inert gas, Nak etc.	250,000	15,000	265,000
Total Material and Labor	$ 878,000	$ 183,000	$ 1,061,000
Contingencies	263,000	54,000	317,000
Total	$ 1,141,000	$ 237,000	$ 1,378,000

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[4457]

I—*Miscellaneous Reactor Plant Equipment and Facilities*

Description	*Material*	*Labor*	*Total*
1. Office furniture and equipment	$ 18,000	$ 2,000	$ 20,000
2. Transportation equipment	5,000		5,000
3. First aid equipment	2,000		2,000
4. Maintenance tools and equipment	80,000	20,000	100,000
5. Waste disposal equipment	24,000	6,000	30,000
6. Shipping casks	120,000	6,000	126,000
7. Miscellaneous systems and power plant equipment	195,000	35,000	230,000
8. Cold element assembly equipment	80,000	11,000	91,000
Total Material and Labor	$ 524,000	$ 80,000	$ 604,000
Contingencies	78,000	12,000	90,000
Total	$ 602,000	$ 92,000	$ 694,000
Total Material and Labor	$18,233,400	$5,235,400	$23,468,800
J—Construction plant, equipment rental, tools and fee			$ 2,977,000
K—Spare parts, control rods, rod actuators, core and blanket elements			160,000
L—Preoperation testing after construction			350,000
M—Personnel training			500,000
N—Initial operation low to full load			550,000
O—Interest during construction			1,800,000
P—Engineering services and expenses			900,000
Q—Local taxes etc.			519,200
R—Working capital			1,175,000
TOTAL ESTIMATED PLANT COST			$32,400,000

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12/31/56

[4458]

PRDC

ENRICO FERMI ATOMIC POWER PLANT

A—Structures and Improvements

General Fill and Site Improvements

The reactor plant site and turbine-generator side, general fill and improvements was prepared by Detroit Edison Company covering the entire project and it was agreed between DE Co and PRDC (in Paragraph 1 of the Steam Agreement of October 20, 1956) to split the cost of common improvements on a 50-50 basis with PRDC adding to these figures any additional improvements required only for the reactor plant.

Attached sheet shows CA Inc.'s estimate of work and portions completed and their actual cost.

This estimate and the actual costs to date are in line with costs experienced by public utilities in developing a new site for a steam electric generating station.

[4459]

A—Structures and Improvements

Description	*Estimate Material*	*Labor*	*Total Est.*	*Work Completed Actual Direct Cost to PRDC*
General Fill				
1. Fill and muck removal + design		$135,000	$135,000	$152,580.87
*2. Rip-rap	$ 12,000	17,000	29,000*	-0-

Site Improvements

**3. Finish grading and gravel	9,000	6,000	15,000**	
4. Roads and parking area	20,000	45,000	65,000	
5. Railroad track	18,000	22,000	40,000	
***6. Yard piping all services	18,000	27,000	45,000***	
7. Storm sewers, drains and catch basins	10,000	20,000	30,000	
8. Yard Lighting	5,000	10,000	15,000	6,370.47
9. Fencing	6,000	4,000	10,000	
10. Landscaping	5,000	10,000	15,000	
Total Labor and Material	$103,000	$296,000	$399,000	
Contingencies 10%	10,300	27,600	39,900	
Total Including Contingencies	$113,300	$325,600	$438,900	
Design on Items Engineered by DE Co at 4.5% of direct			Included above	

NOTE: All of the above items except those with asterisks (*) are to be performed by the DE Co. and PRDC is to be billed for ½ of the cost in accordance with the Service Agreement of October 20, 1956. Estimates are those furnished by DE Co. as ½ of their anticipated cost.

* "Rip-rap" costs are now expected to be zero since rip-rap has been obtained from excavation for the reactor containment vessel foundation, without costs over and above those included in excavation estimate, see Page B-1.

(See Notes continued on next page)

[4460]

A—Notes (Contd.)

** "Finished grading and gravel fill" is an allowance for leveling and grading the site after construction as is normal practice with all construction work.

*** "Yard service piping" consists of yard drainage piping, fire protection piping and hydrants, lawn sprinkler piping, etc and is in line with cost of similar work for conventional steam plants.

[4461]

B—Reactor Plant Structures

1. *Reactor Containment Vessel Foundations and External Concrete Work*

		Material	*Labor*	*Material*	*La*
*Excavation test pit			Lot		$ 2
*Excavation reactor foundation					
Earth—16,200 cu yd)					
Rock— 4,000 cu yd)					44
Reinforcing steel	450 Ton	$150	$125	$ 67,500	56
Forms	21,000 sq ft	1.00	1.50	21,000	31
Concrete mix and place	5,800 cu yd	18.	8.	104,400	46
Waterproofing vessel to grade	10,000 sq ft	.10	.20	1,000	2
Flashing and waterstop			Lot	2,500	5
Backfill	9,000 cu yd	.50			4
Sump and piping			Lot	2,000	3
Pipe sleeves & neutron shields			Lot	15,000	12
**Pregrouting rock			Lot	15,000	16
Total Material and Labor				$228,400	$242
Total				$471,000	
Contingencies 10%				47,100	
Total with Contingencies				$518,100	

* Excavation estimated at $46,000 + 10 per cent Contingencies = $50,600.
This work completed—total actual cost (C. J. Rogers Co, Monroe) $56,5

** Pregrouting rock estimated at $25,450 + 10% Contingencies = 28,000
This work completed—total actual cost (Raymond Concrete Pile Co, New York) 19,6

Approximately 90 percent of the remaining work under this item contracted for on a unit price basis. Most of this is under a contra dated October 26, 1956 between PRDC and Grafton Construction C of Monroe, Michigan.

To date the work under contract is approximately 75 per cent com plete and the contract unit prices and the quantities of work performe

to date indicate this work will be completed for something less than the estimate.

The remaining 10 per cent of the concrete work will not be contracted for until after the containment vessel erection is complete.

There is every indication that when completed, the work under this section will come well within the estimated cost.

This work is very similar to conventional steam electric generating stations. Unit prices and lump sums used for estimating are based on steam plant costs for similar work in Michigan and Ohio.

[4462]

B—Reactor Plant Structures

2. *Containment Vessel*

Purchased from Chicago Bridge & Iron Company under Contract dated December 24, 1956.

	Estimate	*Contract Price*
72' dia vessel erected	$566,000	$553,700
Escalation 10%	56,000	(open)
Allowance for extras such as additional air lock doors, change in size of openings, etc.	30,000	(open)
Extra for expected 6-day erection work week	12,000	15,000
Allowance for antisweat insulation on vessel above concrete walls	47,000	—
Extra for element exit connections	9,650	(open)
Extra for testing after erection	5,000	5,000
Extra for erection derrick suitable to erect overhead crane	9,000	9,700
Extra for pickling steel	600	(open)
Total	$735,250	$585,400
Contingencies 10%	73,550	
Total with Contingencies	$808,800	

Note: Allowance for escalation of 10% still appears adequate.

[4463]

B—Reactor Plant Structures

3. Internal Structural and Concrete Work and Equipment Decay Tanks

		Mat.	Labor	Material	Labor
Forms	12,000 sf @	$ 1.00	$ 1.60	$ 12,000	$ 19,200
Reinforcing steel	107 T @	150.00	135.00	16,050	14,445
Concrete mix and place	2,130 cy @	18.00	10.00	38,340	21,300
*Steel plate shielding	950 T @	350.00	200.00	332,500	191,000
Floor finish		Lot		1,000	3,500
Sump pump & motor & piping		Lot		10,000	8,000
Lead shielding		Lot		22,000	90,000
**Structural Steel	540 T @	300.00	150.00	162,000	81,000
***Equipment decay tanks		Lot		80,135	31,545
#Hold down plate and actuator				167,500	101,500
Total Material and Labor				$841,525	$511,490
				Total	$1,353,015
			Contingencies 10%		135,385
			Total with Contingencies		$1,488,400

* Bids on steel plate shielding of $354 per ton have been received. (R. C. Mahon Co)

** Bids on structural steel at $224 per ton have been received. (Ingalls Iron Works Co)

*** Equipment decay tanks

Assume 5 tanks required as shown on APDA Dwg 6XN1109.
Assume tanks carbon steel 1" thick with stainless steel liner.

		Mat.	Labor	Material	Labor
5 tanks with stainless liner	62 T	$450.00	$150.00	$27,900	$ 9,300
Tank supports	15 T	300.00	115.00	4,500	1,725
Steel covers	152 T	300.00	125.00	45,600	19,000
Concrete plugs	61 cy	35.00	25.00	2,135	1,525
*** Total Material and Labor				$80,135	$31,500
			Total		$111,685

This estimate based on preliminary APDA design.

#To be purchased by APDA pursuant to proposal from General Electric Company.

[4464]

B—Reactor Plant Structures

4. Element Decay and Storage Building

Estimate based on preliminary APDA and CA Inc. Design. Substructure heavy concrete construction.

Superstructure conventional light panel construction.
Element storage under water.

		Mat	*Labor*	*Material*	*Labor*
Excavation earth	3,000 cy		$ 2.00		$ 6,000
Forms	25,500 sf	$ 1.00	1.50	$ 25,500	38,250
Reinforcing steel	195 T	150.00	125.00	29,250	24,375
Concrete mix & place	2,500 cy	18.00	8.00	45,000	20,000
Waterproofing				1,000	3,000
Superstructure walls, panel construction	12,200 sf	1.15	.75	14,030	9,150
Structural steel	100 T	300.00	150.00	30,000	15,000
Roof deck & roofing	4,500 sf	1.70	1.50	7,650	6,750
Doors & hardware		Lot		10,000	5,000
Hand railing	250 ft	2.50	1.00	625	250
View windows in concrete		Lot		18,000	10,000
Heating, lighting & ventilation		Lot		15,000	15,000
Unwatering		Lot		3,000	20,000
Overhead crane 15 ton	1			11,530	4,000
Lead shielding		Lot		15,000	15,000
Miscellaneous & painting		Lot		3,000	8,000
Total Material & Labor				$228,585	$199,865
Total				$428,450	
Contingencies 10%				42,850	
Total with Contingencies				$471,300	

[4465]

B—Reactor Plant Structures

5. *Repair Shop and Shipping Building*

Estimate based on APDA preliminary design, conventional construction.

	Material	Labor	Material	Labor
Excavation—500 cu yd		$ 2.00		$ 1,000
Reinforcing steel—17 T	$150.	125.	$ 2,550	2,125
Concrete—340 cu yd	18.	8.00	6,120	2,720
Forms—5,600 sq ft	1.00	1.50	5,600	8,400
Structural Steel—50 T	300.	150.	15,000	7,500
Block wall—6,800 sq ft	1.15	.75	7,820	5,100
Roof deck and roofing—3,300 sq ft	1.75	1.50	5,775	4,950
Crane—50 T		Lot	25,000	8,000
Sash and doors		Lot	1,500	2,000
Painting and miscellaneous work		Lot	2,000	5,000
Heating, ventilation and lighting			15,000	8,000
Total Material and Labor			$86,365	$54,795
Total				$141,160
Contingencies 10 per cent				14,140
Total including Contingencies				$155,300

[4466]

B—Reactor Plant Structures

6. *Office Building*

Reference APDA Drawing 6XN1137
Building approximately 72′ x 32′ x 66′ = 152,724 cu ft
Office buildings average between $10 and $25 per sq ft of floor area depending on design, site and refinements
Average steam plant structure cost is approximately $1.10 per cu ft

Assume office building complete with lighting, heating, plumbing, furniture, partitions etc = $1.80 per cu ft

$1.80 x 152,724 cu ft = $274,903

Use $275,000

Split Between Material and Labor

Material	$125,000
Labor	150,000
Total	$275,000
Contingencies 10 %	27,500
Total with Contingencies	$302,500

[4467]

—Reactor Plant Structures

7. *Boiler Rooms*

Preliminary design indicated three boiler rooms located around perimeter of the containment vessel each to house one boiler. Heavy construction due to sodium.

Each boiler room approximately 66′ x 16′ x 33′ = 34,848 cu ft each

Average powerhouse masonry and concrete = $1.10 per cu ft

Assume heavier construction than powerhouse and smaller volume use $2.10 per cu ft

34,848 cu ft x 3 x $2.10 = $219,542

Use $220,000

Assume Split Material and Labor

Material	$ 95,000
Labor	125,000
Total	$220,000
Contingencies 10%	22,000
Total with Contingencies	$242,000

[4468]

B—Reactor Plant Structures

8. *Service Building*

Preliminary design indicates building 36′ x 55′ x 105′ three story structure, first floor heavy concrete construction, remaining two stories conventional construction, masonry or panel.

Building to house laboratories, testing equipment, etc

Assume interior construction more extensive than powerhouse with more office space, lighting, heating, etc. Estimated cost per cu ft $1.95

36′ x 55′ x 105′ = 207,800 x $1.95 = $405,170

Use $400,000

Assume Split Material and Labor

Material	$200,000
Labor	200,000
Total	$400,000
Contingencies 10%	$40,000
Total with Contingencies	$440,000

[4469]

B—Reactor Plant Structures

9. *Hot Cove Building*

Preliminary design indicates a building approximately 30′ x 40′ x 12′ of mass concrete

Building to be used for inspection, disassembly and testing of radioactive equipment.

Assume mass concrete construction $2.25 per cu ft

30′ x 40′ x 12′ = 14,400 cu ft x $2.25 = $32,400

Use $35,000

Assume Material and Labor Split

Material	$15,000
Labor	20,000
Total	$35,000
Contingencies 10%	3,500
Total with Contingencies	$38,500

[4470]

B—Reactor Plant Structures

10. *Sodium Storage and Inert Gas Building*

Preliminary design indicates building approximately 70′ x 70′ x 24′ with substructure of mass concrete and superstructure of conventional construction.

Building to house sodium storage tanks, sodium cleanup system, sodium heating and unloading facilities, in substructure. Superstructure to house inert gas storage and cleanup system.

Assume substructure cost $2.60 per cu ft.

Assume superstructure cost $1.10 per cu ft.

70′ x 70′ x 12′ = 59,800 cu ft x $2.60 = $155,480
70′ x 70′ x 12′ = 59,800 cu ft x 1.10 = $ 65,780

$221,260
Use $225,000

Assume Material and Labor split

Material	$110,000
Labor	115,000
Total	$225,000
Contingencies 10%	22,500
Total with Contingencies	$247,500

[4471]

B—Reactor Plant Structures

11. *Control Room, Relay and Switchgear Rooms*

Preliminary design indicates a building approximately 36′ x 30′ x 44′ of conventional construction.

Building to house reactor plant controls and electrical switching equipment.

Assume cubic foot cost slightly higher than conventional steam plant due to small volume. Use $1.50 per cu ft.

36′ x 30′ x 44′ = 47,520 x $1.50 = $79,280
Use $80,000

Assume Material and Labor split:

Material	$35,000
Labor	45,000
Total	$80,000
Contingencies 10%	8,000
Total with Contingencies	$88,000

[4472]

B—Reactor Plant Structures

12. *Electrical Equipment Room*

Preliminary design indicates a building approximately 30′ x 70′ x 44′ of light construction adjacent to control room to house electrical equipment — transformers, cubicles, breakers, etc.

Assume cost per cubic foot somewhat less than steam plant construction, use .90 per cu ft.

30′ x 70′ x 44′ = 92,400 cu ft x .90 = $83,160
Use 83,000

Assume Material and Labor split:

Material	$35,000
Labor	48,000
Total	$83,000
Contingencies 10%	8,300
Total with Contingencies	$91,300

[4473]

B—Reactor Plant Structures

13. *Connecting Passageways Between Buildings*

Enclosed passageways to connect the various buildings so that personnel may travel between buildings without going out of doors. Passageways to be of light construction.

Assume .90/cu ft.	
60′ x 15′ x 10′ = 9,000 cu ft @ .90 =	$ 8,100
150′ x 6′ x 9′ = 8,100 @ .90 =	$ 7,290
Total	$15,390
Use	$16,000

Assume material and labor split	
Material	$7,000
Labor	9,000
Total	$16,000
Contingencies 10%	1,600
Total with Contingencies	$17,600

[4474]

B—Reactor Plant Structures

14. *Stack*

Assume stack for disposal of waste gases and vapors required with height of 200 ft above grade. Assume selfsupporting concrete stack with concrete foundation. Top ID 8 ft.

Assume stack cost erected		$60,000
Foundation Material		15,000
Foundation Labor		10,000
Assume material and labor split		
Material	$75,000	
Labor	10,000	
Total	$85,000	
Contingencies 10%	8,500	
Total with Contingencies	$93,500	

[4475]

B—Reactor Plant Structure

15. *Ventilating Rooms for Containment Vessel*

Assume two rooms required to house ventilating containment vessel area above operating floor level. Each building complete with 75 ft steel stack to exhaust hot air above building height.

Assume building size 19′ x 20′ x 8′, of light concrete construction, say $2.50/cu ft.

19′ x 20′ x 8′ x 2′ = 6080 cu ft x $2.50 =		$15,200
2 steel stacks erected		10,000
		$25,200
	Use	$25,000
Assume material and labor split		
Material	$14,000	
Labor	11,000	
Total	$25,000	
Contingencies 10%	2,500	
Total with Contingencies	$27,500	

[4476]

C—Reactor Plant Equipment

1. *Primary Shield Tank*

*Chicago Bridge & Iron proposal to APDA for Primary shield tank erected	$106,000*
Allowance extras and escalation for nuclear operation	25,000
Provision for additional penetrations, etc	
Graphite shieling	175,000
500,000 lb @ 35¢ per lb	
Price information obtained from Hanford	

Thermal shielding—steel plate		52,500
150 T @ $350 per T		
Cooling channels		10,000
Allowance for cooling of graphite		
Heat insulation in place		50,000
*Escalation		14,000*
Erection of graphite shielding, thermal shielding and cooling channels		45,000
Total		$477,500
Assume Material and Labor split		
Material	$382,500	
Labor	95,000	
Total	$477,500	
Contingencies 15%	61,600	
Total Including Contingencies	$539,100	

* Primary shield tank to be purchased (erected) by APDA. Extras, graphite shielding, thermal shielding, cooling channels, insulation, etc., to be purchased by PRDC.

[4477]

C—Reactor Plant Equipment

2. *Reactor Vessel Including Steel Sheilding, internal structures and Heating System*

*Combustion Engineering Proposal to APDA	$ 915,800*
**Allowance for Extras such as loop stub pipings, thermocouples, expansion joints, etc for nuclear operation	75,000**
*Escalation	91,000*
*Heating system material	20,000*
Heating coils for keeping sodium fluid during reactor shutdown	
*Erection—Estimated weight—250 T	72,500*
*Erection—Heating System	10,000*

*Steel Shielding and internal structures ... Allowance for miscellaneous plate and structure shapes required for final operation		10,000*
		$1,194,800
Split Material and Labor		
Material	$1,107,300	
Labor	87,500	
Total	$1,194,800	
Contingencies 15%	179,100	
Total with Contingencies	$1,373,900	

* Reactor vessel, heating system, steel shielding and ⅓ of extras such as loop stub piping etc. to be purchased and erected by APDA.

** Two-thirds of extras such as loop stub piping, etc. to be purchased by PRDC.

[4478]

C—Reactor Plant Equipment

3. *Rotating Plug Including Shield Disks, Index System, Controls, Drives, Nak and Gas Seals*

*Rotating Plug—Combustion Engineering Proposal by ARDA	$346,350*
*Index System & Drives—General Electric Proposal to APDA	60,000*
Steel Shield Disks—erected 90 T @ $1,100/T based on material prices from GE Co	100,000
Nak and Gas Seals erected	20,000
*Escalation	50,000*
*Erection—200 T @ $250/T	50,000*
	$626,350

Split Material and Labor.	
Material	$556,350
Labor	70,000
Total	$626,350
Contingencies 15%	93,950
Total with Contingencies	$720,300

* Plug assembly and Index System and Drives to be purchased and erected by APDA.

PRDC to purchase extras, steel shield disks, Nak & gas seals.

[4479]

C—Reactor Plant Equipment

4. *Control Rods Including Fast Neutron Poison*

Two rods to be purchased by APDA of a total of 8 required

*Allis-Chalmers proposal to APDA for 2 rods	$ 34,608*
Allowance for fast neutron poison for nuclear operation—approx 2 kg of Boron 10 for 2 rods	12,000
(Actual material price is classified information)	
Allowance for shielding for nuclear operation	4,000
*Escalation	3,400*
	$ 54,008
Assume 10 per cent reduction on remaining 6 rods due to cost of engineering and development in cost of first 2 rods	
$\frac{54,008 - 10\%}{2} = 24,300 \times 6 =$	145,800
	$199,808

Shim rods—2 required
Fast neutron poison not required
Less difficult design
Assume ⅓ cost of control rods
Say $7,000 each = ... 14,000

Installation control and shim rods		
Require unloading, handling, cleaning		
Assembly and installation—say $1,500 each		
10 rods x $1,500 =		15,000
Material	$213,800	
Labor	15,000	
Total	$228,800	
Contingencies 15%	34,200	
Total with Contingencies	$263,000	

*Two control rods to be purchased by APDA. PRDC to purchase all but two rods.

[4480]

C—Reactor Plant Equipment

5. *Control Rod Actuators*

Two (2) control rod actuators to be purchased by APDA.
Total 10 required.

*General Electric proposal to APDA for 2 actuators	$ 51,200*	
*Escalation	5,100*	
Allowance for extras for nuclear operation	5,000	
Total for two (2) rods	$ 61,300	

Assume 10 per cent reduction on 6 remaining rods due to engineering and design being complete on first 2

$$\frac{\$61,300 - 10\% = \$27,600 \times 6}{2} = \$165,600$$

Shim rod actuators—2 required.
Assume same price as control rod actuators
2 x 27,600 = 55,200

Erection.
Includes unloading, storing, handling, installation and test. Say $2,500 ea
10 x $2,500 = 25,000

Material	$282,100
Labor	25,000
Total	$307,100
Contingencies 15%	92,100
Total with Contingencies:	$399,200

* APDA to purchase 2 control rod actuators.
PRDC to purchase 8 control rod actuators.

[4481]

C—Reactor Plant Equipment

6. *Ionization Chambers*

Ionization chambers located in shielding around reactor vessel for measurement of neutron and gama ray field intensity.

The design and characteristics of ionization chamber systems is based on a Bendix Report to APDA dated November 17, 1955, and descriptive data and material received from manufacturers supplying equipment of this type, Westinghouse, RCA and others.

Material	$30,000
Labor	6,000
Total	$36,000
Contingencies 15%	5,400
Total with Contingencies	$41,400

[4482]

C—Reactor Plant Equipment

7. *Overhead Crane*

Overhead crane on circular track mounted near the top of the containment vessel for lifting reactor equipment. Crane with 125 ton main hook and 25 ton auxiliary

hook, each with gripper mechanism for remote operation.

Crane—125 T with 25 T auxiliary hook	$145,000
Remote Controls	30,000
Erection	25,000
	$200,000

Split Material and Labor

Material	$175,000
Labor	25,000
Total	$200,000
Contingencies 15%	30,000
Total with Contingencies	$230,000

Purchase of a larger crane has been contracted for by PRDC, by contract with Whiting Corporation dated December 19, 1956:

150 T crane	
30 T auxiliary	
Remote control operation for inside or outside operation	$184,115
Max Escalation not to exceed 5% =	$ 9,200
Maximum Price	$193,315

Original estimate was based on preliminary design.

[4483]

C—Reactor Plant Equipment

8. *Offset Element Handling Mechanism*

A device for removing and installing fuel elements in the reactor, to be purchased and erected by APDA.

*General Electric	
Proposal to APDA for offset handling mechanism	$195,500*
Allowance for extras for nuclear operation	35,400

Allowance for shielding for nuclear operation	6,000
*Escalation	35,000
*Erection assume equipment shipped in pieces requiring field assembly, installation and test. Allow	60,000
Material 266,900	
Labor 60,000	
Total $326,900	
Contingencies 15% 48,900	
Total with Contingencies ... $375,800	

*APDA to purchase and erect offset handling mechanism.
PRDC to purchase extras and shielding for nuclear operation.

[4485]

C—Reactor Plant Equipment

9. *Element Memory System*

An electronic recording device for keeping an automatic inventory of the positions of all core and blanket elements in the reactor, decay storage and in transit.

Estimating figures obtained by APDA mechanical handling section as a result of their conversations with American Machinery and Foundry Company.

Material	$220,000
Labor	80,000
Total	$300,000
Contingencies 15%	45,000
Total with Contingencies ...	$345,000

[4486]

C—Reactor Plant Equipment

10. *Element Transfer Rotor and Drive*

A device for transferring elements from reactor to transfer cask car.

*General Electric Co. proposal to APDA		$95,000*
Allowance for Extra for Nuclear Operation		10,000
*Escalation		20,000*
*Assume equipment shipped disassembled requiring field assembly installation and test—Allow		35,000*
Material	$130,000	
Labor	35,000	
Total	$165,000	
Contingencies 15%	24,700	
Total with Contingencies	$189,700	

*APDA to purchase and assemble element transfer rotor and drive. PRDC to purchase extras for nuclear operation.

[4487]

C—Reactor Plant Equipment

11. *Element Transfer Cask and Car*

Shielded mobile car for transferring radioactive elements from reactor plant to decay storage. Car to be complete with cooling equipment, element lifting device, storage racks, etc.

This method of element removal has been evaluated by Dr. Zinn and found feasible and he is now engaged in further design work on the cask car.

Estimating figures obtained from American Machinery & Foundry Co. by APDA mechanical handling section as a result of discussions relative to this type of equipment:

Material	$400,000
Labor	10,000
Total	$410,000
Contingencies 15%	61,000
Total Including Contingencies	$471,000

[4488]

C—Reactor Plant Equipment

12. *Element Transfer and Cleanup*

Equipment necessary for transferring radioactive elements from cask car through a cleanup process to decay storage. Includes crane with gripper mechanism, steam cleaning chamber with air lock valves and necessary steam piping.

Estimating figures obtained from preliminary designs made by APDA mechanical handling section, and information obtained from American Machinery and Foundry.

	Material	*Labor*
Crane with gripper mechanism remote controlled	$40,000	$ 5,000
Steam cleaning chamber, stainless steel lined	15,000	5,000
3 air lock valves, quick opening	45,000	5,000
1 viewing window	10,000	3,000
Piping valves and fitting	25,000	7,000
Gas cooling system including piping storage and dump tank	40,000	8,000
Element pot gripper	15,000	5,000
Miscellaneous allowance	40,000	2,000
Total Material and Labor	$230,000	$40,000
Total	$270,000	
Contingencies 15%	40,500	
Total including Contingencies	$310,500	

[4489]

C—Reactor Plant Equipment

13. *Underwater Hydraulic Operated Cart*

Cart for receiving elements from steam cleaning system and transporting to storage area. This entire operation is carried on underwater by remote control.

Estimating figures obtained from APDA mechanical handling section and their conversations with manufacturers.

Material	$ 80,000
Labor	20,000
Total	$100,000
Contingencies 15%	15,000
Total with Contingencies	$115,000

[4490]

C—Reactor Plant Equipment

14. *Decay Storage Racks*

Underwater storage racks for storage of 1200 blanket elements, and 50 core elements stored in movable carts including supports, cart drive, shielding, index system etc. All material to be stainless steel.

Allowance is made for the following items based on very preliminary design.

	Material	*Labor*	*Material*	*Labor*
Blanket element storage racks 1200 racks @	$ 170	$ 25	$204,000	$ 30,000
Core element storage carts 50 movable carts @	2,400	300	120,000	15,000
Steel cart ring and corer 5,100 sq ft @	.80	.80	40,800	40,800
*Cart Drive and shielding			100,000	15,000

*Index System			46,000	15,000
2 sealed valves for element entrance and exit			15,700	2,700
Graphite shielding–10,000 lb		.35	.25 3,500	2,500
Plate shielding–60 T	350	150	21,000	9,000
			$551,000	$130,000

Total $681,000
Contingencies 15% 102,100

Total Including Contingencies ... $783,100

* (Estimating figures from American Machinery and Foundry Company.)

[4491]

C—Reactor Plant Equipment

15. *Decay Building Gas and Water Systems, and Disassembly Machinery*

Radioactive element storage under water to provide a biological shield requires water purification, filteration and cooling, an inert gas system in areas where elements are transferred from water storage for shipping and also for fire protection. Disassembly machinery designed for underwater operation is required for preparing elements for shipment to government laboratories.

	Material	*Labor*
Water purification system with radioactive filters 1,000 gpm	$ 50,000	$10,000
2—Heat exchangers water to air for cooling storage water 500 gpm	30,000	10,000
2—Circulating water pumps and motors—500 gpm	20,000	5,000
Inert gas system for cooling, and blanket includes piping valves and fittings, filters, etc.	40,000	20,000
Disassembly machinery:		
Saw	6,000	1,000
Manipulators	75,000	10,000

Inspection tables	10,000	5,000
Crane	15,000	2,000
Miscellaneous	44,000	7,000
Total	$290,000	$70,000
Total Material and Labor	$360,000	
Contingencies 15%	54,000	
Total including Contingencies	$414,000	

[4492]

D—Primary System Na to Na

1. *Sodium Pumps Including Sump Tanks and Drives and Heating*

*3 pumps required—1 pump to be purchased by APDA pursuant to proposal from Bryon Jackson for $146,000 and 1 check valve to be purchased by APDA pursuant to proposal from Eduant Valves Inc. for $7,700.

Assume 10% reduction on remaining 2 pumps.

	Material	*Labor*
*3 pumps and motors	$410,000	$20,000*
*3—16" pump check valves	23,000	5,000*
pump heating	15,000	6,000
3 sump tanks and plugs	32,000	9,000
	$480,000	$40,000
Total	$520,000	
Contingencies 30%	156,000	
Total with Contingencies	$776,000	

*APDA to purchase and install 1 pump and 1 check valve.

PRDC to purchase and install remaining pumps, pump heating, sump tanks and plugs.

[4493]

D—Primary System Na to Na

2. *Pump Tank Insulation*

Heat insulation
High temperature block, applied to exterior of pump tanks
Estimated installed price for 3 pump tanks including all materials and labor. $15,000
Contingencies 30% 4,500

Total with Contingencies $19,500

This item not separated between material and labor as insulation is normally purchased applied for a lump sum price.

[4494]

D—Primary System Na to Na

3. *Intermediate Heat Exchanger*

Three heat exchangers required for transfer of heat for primary sodium cycle to secondary sodium cycle.

Preliminary estimating figures obtained by APDA from Griscom Russell, a heat exchanger manufacturer.

Heat exchangers including supports...$ 925,000
Erection assume shipped assembled... 30,000

Total .....$ 955,000

Contingencies 30% 286,500

Total with Contingencies $1,241,500

[4495]

D—Primary System Na to Na

4. *Heat Exchanger Insulation*

High temperature block applied on the exterior surface of heat exchanger.

Estimate material and labor for insulation in place	$15,000
Contingencies 30%	4,500
Total with Contingencies	$19,500

This item not separated between material and labor as insulation is normally purchased applied for a lump sum price.

[4496]

D—Primary System Na to Na

5. *Main Loop Piping Including Blanket Flow and Overflow Piping with Supports*

Three Loops. These include:

Approximately 210 ft of 30" piping from reactor to intermediate heat exchangers and pump tanks.

Approximately 200 ft of 16" piping from pump tank check valve to division point between blanket and core section of reactor.

Approximately 120 ft of 14" piping from division point to core inlet plenum chamber.

Approximately 80 ft of 6" piping from division point through throttle valve to blanket inlet plenum chamber.

Approximately 80 ft of 6" piping overflow from top of reactor datum line to overflow tank.

All piping stainless steel. Estimating prices obtained from M. W. Kellogg Company.

*Pipe including heating	$165,000*
*Labor	65,000*
Total	$230,000
Contingencies 30%	69,000
Total including contingencies	$299,000

* APDA to purchase one of 3 loops, in accordance with proposal received by APDA from Kellogg Company for $59,000.
APDA to install this loop.
PRDC to purchase and install remaining two loops.

[4497]

D—Primary System Na to Na

6. *6 Inch Blanket Flow Control Valves with Bellows Seals*

3 valves required.

APDA to purchase one valve in accordance with proposal of Copes-Vulcan for $14,875.

Assume that large amount of engineering required for first valve will not be repeated; remaining two valves should be about one-half the cost of first valve.

*3 Valves	$30,000*
Labor	3,000
Total	$33,000
Contingencies 30%	9,900
Total with Contingencies	$42,900

* APDA to purchase and install one of 3 valves.
PRDC to purchase and install remaining 2 valves.

[4498]

D—Primary System Na to Na

7. *Secondary Containment and Leak Detection System*

This system consists of encasing the piping in a metal covering with a space between the main pipe and the covering into which an inert gas blanket is maintained to prevent fire in case of a leak as well as a means of containing and confining a leak. Instruments mounted in this secondary containment will record any leaks which may occur. This is a gas tight carbon steel pipe encasement.

	Material	*Labor*
690 ft pipe secondary containment	$20,000	$ 8,000
Secondary containment 3 sodium pumps @ $10,000 ea	30,000	12,000
Total Material and Labor	$50,000	$20,000
Total		$70,000
Contingencies 30%		21,000
Total including Contingencies		$91,000

[4499]

D—Primary System Na to Na

8. *Pipe Insulation Including Boron Carbide Covering*

Heat Insulation:

High temperature insulation and a shielding outer covering such as boron carbide

Estimate Material and Labor for insulation in place	$20,000
Contingencies 30 per cent	6,000
Total with Contingencies	$26,000

This item not separated between material and labor as insulation is normally purchased applied for a lump sum price.

[4500]

D—Primary System Na to Na

9. *Overflow Tank*

This is a stainless steel tank provided to receive overflow of sodium from the reactor caused by load changes and expansion of sodium due to temperature change.

Tank approximately 8′ dia x 38′ high. Estimating prices obtained from Pittsburgh Des-Moines and Graver tank

Material	$20,000
Labor	5,000
Total	$25,000
Contingencies 30%	7,500
Total with Contingencies	$32,500

[4501]

D—Primary System Na to Na

10. *Overflow Pumps and Motors*

2 pumps and motors required 300 gpm ea for recirculating sodium from the overflow tank back to the primary sodium system and to sodium cleanup and storage. Pumps will also be used to fill and drain reactor.

Estimating figures obtained from Byron Jackson and Ingersoll-Rand.

2 pumps with motors and plugs, 300 gpm	$100,000
Labor	25,000
Total	$125,000
Contingencies 30%	37,500
Total with Contingencies	$162,500

[4502]

E—Secondary System Na to Water

1. *Steam Generators*

Three (3) required for transferring heat from secondary sodium cycle to steam cycle. Each to have a capacity of approximately 350,000 lbs. of steam per hour.

Preliminary estimating figures obtained from B & W and Griscom Russell indicate three (3) steam generators will cost $600,000
Labor 50,000

Total $650,000
Contingencies 30% 195,000

Total with Contingencies $845,000

[4503]

E—Secondary System Na to Water

2. *Steam Generator Insulation*

High temperature insulation applied on the outer surface of the steam generators.

Estimated Cost in Place $20,000
Contingencies 30 per cent 6,000

Total with Contingencies $26,000

This item not separated between material and labor as insulation is normally purchased applied for a lump sum price.

[4504]

E—Secondary System Na to Water

3. *Steam Generator Supports*

Concrete and steel foundations required for setting the three steam generators.

Material	$3,000
Labor	1,500
Total	$4,500
Contingencies 30 per cent	1,300
Total with Contingencies	$5,800

[4505]

E—Secondary System Na to Water

4. *Sodium Pumps and Drives*

3 pumps required approximately ½ capacity of primary sodium pumps. Same type as primary pumps.

Estimating figures obtained from Byron Jackson and Ingersoll-Rand.

	Material	*Labor*
3 pumps and motors	$360,000	$ 8,000
Pump heating	12,000	4,000
3 surge tanks	18,000	3,000
	$390,000	$15,000

Total	$405,000
Contingencies Added 30%	121,500
Total with Contingencies	$526,500

[4506]

E—Secondary System Na to Water

5. *Pump Insulation*

High temperature insulation applied to the exterior surface of the sodium pumps.

Estimated cost insulation in place	$7,000
Contingencies 30%	2,100
Total with Contingencies	$9,100

This item not separated between material and labor as insu on is normally purchased applied for a lump sum price.

[4507]

E—Secondary System Na to Water

6. *Pump Supports*

Necessary concrete and steel foundations for setting 3 sodium pumps.

Material	$3,000
Labor	1,500
Total	$4,500
Contingencies 30%	1,300
Total with Contingencies	$5,800

[4508]

E—Secondary System Na to Water

7. *Main Loop Piping, Supply and Return Including Supports*

3 loops consisting of 16" and 12" stainless steel pipe

System runs from intermediate heat exchanger through reactor building to steam generators and return.

Estimating figures obtained from Grinnell.

Approximately 550' pipe	$102,000
Labor	30,000
Total	$132,000
Contingencies 30%	39,600
Total with Contingencies	$171,600

[4509]

E—Secondary System Na to Water

8. *Pipe Heating and Controls*

Necessary electric heating of piping to keep sodium in a liquid state to insure continuous flow through piping.

System consists of standard electric heating coils wrapped around piping with necessary temperature controls.

550′ pipe heating and pump tank heating for 3 pumps	$ 14,000
Labor	6,000
Total	$ 20,000
Contingencies Added 30%	6,000
Total with Contingencies	$ 26,000

[4510]

E—Secondary System Na to Water

9. *Secondary Containment and Leak Detection System*

This system consists of encasing the piping in a metal covering with a space between the main pipe and the covering into which an inert gas blanket is maintained to prevent fire in case of a leak as well as a means of containing and confining a leak. Instruments mounted in this secondary containment will record any leaks which may occur. This is a gas-tight carbon steel pipe encasement.

	Material	*Labor*
Secondary containment—550′ pipe	$ 16,000	$ 8,000
Secondary containment—3 sodium pumps @ $8,000	24,000	12,000
Total Material and Labor	$ 40,000	$ 20,000
Total	$ 60,000	
Contingencies 30%	18,000	
Total including Contingencies	$ 78,000	

[4511]

E—Secondary System Na to Water

10. *Pipe Insulation*

High temperature insulation applied to piping.

Insulation material and labor in place	$15,000
Contingencies 30%	4,500
Total with Contingencies	$19,500

This item not separated between material and labor as insulation is normally purchased applied for a lump sum price.

[4512]

F—Liquid Metal Storage

1. *Storage Tanks, 3—15,000 Gal. and 3—6,000 Gal. Tanks*

Tanks suitable for storage of approximately 45,000 gal. of radioactive sodium from reactor plant primary system and 18,000 gal. of nonradioactive sodium from secondary system.

Estimating prices obtained from Chicago Bridge and Iron Co.

6 tanks, 1 stainless, 5 carbon steel.

Material	$150,000
Labor	30,000
Total	$180,000
Contingencies 30%	54,000
Total with Contingencies	$234,000

[4513]

F—Liquid Metal Storage

2. *Tank Heating*

Electric heating system for keeping sodium in a liquid state for immediate use in the reactor plant as required.

Standard electric heating coils to be attached to the exterior of the storage tanks.

Approximately 10,000 Lf electric coil	$ 60,000
Labor	30,000
Total	$ 90,000
Contingencies Added 30%	27,000
Total with Contingencies	$117,000

[4514]

F—Liquid Metal Storage

3. *Tank Supports*

Necessary concrete and steel foundations to support sodium storage tanks.

Material	$ 8,000
Labor	5,000
Total	$13,000
Contingencies Added 30%	3,900
Total with Contingencies	$16,900

[4515]

F—Liquid Metal Storage

4. *Unloading and Purification System Including Nak Cooling*

System for receiving and unloading sodium from tank trucks or tank cars and filtering and pumping to storage

tanks. Purification system provides continuous filtering and cold trapping and cleanup of sodium in storage and in the reactor primary system. This also includes a Nak cooling system for the cold traps. Estimating data obtained from Byron Jackson, Ingersoll Rand, M. W. Kellogg, Crane Co., Chapman Valve Co, and General Electric.

	Material	*Labor*
Unloading station	$ 8,000	$ 2,000
Forwarding pump and motor	15,000	3,000
Cold traps and filters	35,000	7,000
Piping valves and fittings	45,000	12,000
Nak cooling for cold traps	8,000	3,000
Heating system for piping and pumps	35,000	10,000
Secondary containment	15,000	5,000
Inert gas system	14,000	5,000
Miscellaneous allowance	25,000	3,000
Total Material and Labor	$200,000	$50,000
Total	$250,000	
Contingencies 30%	75,000	
Total Including Contingencies	$325,000	

[4516]

G—Other Reactor Plant Equipment, and Facilities

1—*Hot Cove Structure and Equipment*

This equipment and structure to be located in hot cove building consists of 2 concrete rooms approximately 10′ x 10′ x 10′ with 5′ thick concrete walls, 4 shielded viewing windows, 2 shielded doors and remote control handling equipment for handling radioactive materials for inspection and testing.

	Material	*Labor*
2 cove rooms, 5 ft thick concrete	$ 7,000	$12,000
4 viewing windows	40,000	20,000
2 shielded doors	14,000	6,000

2 manupilators remote control	75,000	6,000
2 saws	12,000	3,000
2 cranes remote operated	30,000	3,000
Miscellaneous equipment	30,000	6,000
	$208,000	$56,000

Total	$264,000
Contingencies 30 %	79,200
Total with Contingencies	$343,200

[4517]

G—Other Reactor Plant Equipment and Facilities

2. *Conventional Physics and Chemical Laboratory Equipment*

This includes general laboratory equipment to meet general plant requirements and in addition, equipment needed to measure and account for the incoming U-235 and to check physical dimension of incoming fuel elements and if feasible to evaluate the radioactivity potential of each element.

Equipment to consist of work tables and benches, analysis benches, dark room, and developing equipment, laboratory glassware, balances, scales, measuring devices, low intensity radiation sources, geiger counters, etc.

	Material	*Labor*
Work Tables	$ 15,000	
Analysis Bench	10,000	
Developing equipment and dark room .	10,000	
Laboratory glassware	10,000	
Laboratory balances	5,000	
Scales	5,000	
Geiger counters	1,500	
Low intensity radiation sources	10,000	
Laboratory chemicals and supplies ...	10,000	

Measuring instruments	15,000	
Cameras and X-ray equipment	45,000	
Miscellaneous	8,500	
Total Material and Labor	145,000	$ 5,000
Total		$150,000
Contingencies 30%		45,000
Total including Contingencies		$195,000

[4518]

G—Other Reactor Plant Equipment and Facilities

3. *Health Physics Instruments and Equipment*

The instruments and equipment necessary to detect measure and record the radiation etc. in and around the entire reactor plant.

This will consist of portable and mobile instruments, fixed monitors, laboratory devices and personnel monitors.

Estimating data obtained from manufacturers' catalogs and the following manufacturers: Tracer Laboratory, Nuclear Instruments and Chemical Co., Nuclear Measurement Co. and Technical Associates.

Breakdown of Proposed Instruments

	Material	*Labor*
Beta gamma counter	$ 3,000	$ 600
Beta gamma Ion chamber	3,000	600
Alpha proportional counters	5,000	1,200
Alpha, Beta gamma Ion chamber	2,000	500
Neutron counter	2,000	500
Gamma Ion chamber	2,000	500
Fast neutron recoil proton counter	1,000	300
Alpha contamination probe	5,000	800
Beta gamma contamination probe	6,000	900
Alpha, Beta gamma spot air sampler	100	50
Alpha continuous air sampler	100	50
Beta gamma continuous air sampler	45,000	10,000

Alpha, Beta gamma continuous air sampler	55,000	13,000
Spot air sampler (gases)	500	50
Continuous air sampler (gases)	2,000	500
Alpha, Beta gamma spot water sampler	200	50
Alpha counters	3,000	600
Beta gamma counters	2,500	800
Scalers	6,000	1,500
Automatic sample changer	10,000	5,800
Film badges Beta gamma	500	50
Film badges neutron	800	50
Pocket chamber, Beta gamma	600	50
Pocket chamber, neutron	700	50
Beta gamma Ion chamber, continuous	5,000	1,500
Total Material and Labor	$160,000	$40,000
Total	$200,000	
Contingencies 30%	60,000	
Total including Contingencies	$260,000	

[4519]

G—Other Reactor Plant Equipment and Facilities

4. *Health Physics Wiring and Conduit*

This is the necessary wiring and conduit to connect the fixed monitoring instruments to a central laboratory recording system, for continuous monitoring and recording of radiation levels.

Material	$15,000
Labor	60,000
Total	$75,000
Contingencies 30%	22,500
Total with Contingencies	$97,500

[4520]

G—Other Reactor Plant Equipment and Facilities

5. *Inert Gas System Including Vent Gas System*

A system of Argon gas for blanketing all sodium services as a means of level control fire protection, sealing pump shafts, etc., to prevent oxygen contact with sodium. This also includes a system for purifying contaminated gases for reuse.

Includes unloading facilities, storage tanks, piping valves, fittings, compressors, and purification equipment.

Estimating data obtained from M. W. Kellogg, Grover Tank, Lapp Insulator Co., Fisher Governor Co., Robertshaw-Fulton Co., and Linde Air Products.

	Material	*Labor*
Gas storage tanks—3 tanks	$ 20,000	$12,000
Distribution piping valves and fittings	65,000	30,000
Contaminated gas storage —2 tanks	10,000	5,000
Gas cleanup system including Na bubblers, calcium chip tank, scrubbers, fitters, etc.	50,000	20,000
Regulating and control equipment	15,000	7,000
Miscellaneous allowance	10,000	6,000
Total Material and Labor	$170,000	$80,000
Total	$250,000	
Contingencies 30%	75,000	
Total Including Contingencies	$325,000	

[4521]

G—Other Reactor Plant Equipment and Facilities

6. *Reactor Plant Instrumentation and Control Boards*

The instrumentation necessary to permit the operation of the reactor plant from a control room. Instru-

ments to consist of temperature recorders, flow recorders, reactor output level, radiation level, thermocouples, etc.

Estimating data obtained from Leeds & Northrup, Westinghouse, Radiation Counter Laboratories and Minneapolis-Honeywell Regulator Co.

Type, number, etc., obtained from the instrumentation in use in the various test reactors now in operation.

	Material	*Labor*
Nuclear Instruments:		
Fission products detector	$ 25,000	$ 6,000
Neutron sensing chambers, Bf_3 proportional chambers, fission chambers	18,000	5,000
Servall mechanism	25,000	8,000
Electronic recorders	61,000	12,000
Test equipment	67,000	15,000
*Nonnuclear Instruments:		
Data loggers, scanning and other miscellaneous devices	40,000	20,000
Measuring, recording and control system system for flow, temperature, pressure and level of sodium coolant system and auxiliaries and inert gas blanket system	260,000	50,000
Cabinets, panels, bench boards and cubicles	150,000	25,000
Allowance for miscellaneous equipment	54,000	9,000
Total Material and Labor	$700,000	$150,000
Total	$ 850,000	
Contingencies 30%	255,000	
Total including Contingencies	$1,105,000	

* APDA to purchase and install certain non-nuclear instruments, estimated at $75,000. PRDC to purchase and install remainder.

[4522]

G—Other Reactor Plant Equipment and Facilities

7. *Instrument Wiring and Tubing*

The wiring and tubing necessary to connect the instruments located at various parts of the reactor plant with a central control room.

Material	$100,000
Labor	100,000
Total	$200,000
Contingencies 30%	60,000
Total Including Contingencies	$260,000

[4523]

—Other Reactor Plant Equipment and Facilities

8. *Steam and Feedwater Piping from Steam Generator Outlet to Steam Generator Enclosure Wall*

This is the steam and feedwater piping on the reactor plant side of the division wall between the reactor plant and the turbine-generator plant.

Consists of feedwater piping to steam generators and steam piping from steam generator with necessary valves, fittings, supports and insulation.

	Material	*Labor*	*Material*	*Labor*
ain steam piping—600 ft	$75.00	$16.66	$ 45,000	$10,000
eedwater piping—600 ft	44.16	11.66	26,500	7,000
ain steam manifold			25,000	8,000
ipe supports and hangers	Lot		10,000	15,000
main steam valves—motor operated	6,000	4,000	18,000	12,000
feedwater valves—motor operated	3,500	3,000	10,500	9,000
ittings, elbows, etc			10,000	5,000

Insulation	4,000	10,000
Miscellaneous allowance	1,000	4,000
Total Material and Labor	$150,000	$80,000

Total	$230,000
Contingencies 30%	69,000
Total with Contingencies	$299,000

[4524]

G—Other Reactor Plant Equipment and Facilities

9. *Steam Generator Instrumentation Including Control Air Compressor, Tubing, Etc.*

Instruments necessary for measuring and controlling feedwater and steam flow temperature and pressure. Also necessary recording instruments. These instruments to be electric and air operated. This item also includes the necessary wiring and tubing to connect these instruments with a certain control room.

	Material	*Labor*
Pressure and temperature recorders—steam	$10,000	$ 6,000
Pressure and temperature recorders feedwater	8,000	5,000
Control air compressor and motors	12,000	5,000
Control wiring and tubing	10,000	44,000
Total Material and Labor	$40,000	$60,000

Total	$100,000
Contingencies 30%	30,000
Total including Contingencies	$130,000

[4525]

G—Other Reactor Plant Equipment and Facilities

10. *Accessory Electric Equipment*

The electrical power system for the reactor plant auxiliaries consists of a 4.8 kv distribution system for large motors and loads, a 480 volt distribution system for small motors and miscellaneous plant loads, a 240-120 volt distribution system for sodium and reactor preheating, a direct current (battery) system for essential plant control, and a small capacity alternate d-c system for essential plant control. The estimated capacity of the system is 12,500 kva. This capacity is to be supplied from an on-the-site DE Co 120 kv substation by two DE Co transformers. Either of these transformers is capable of supplying the reactor plant load.

	Material	*Labor*
15 kv metal-clad switchgear—17 units	$127,500	$ 17,000
600 volt metal-clad main switchgear—8 units	32,000	4,000
600 volt motor control center—250 ckt	112,500	25,000
600 volt distribution panels	10,000	5,000
Transformers, 4.8 kv/480 v, 750 kva, 3 phase—2	16,000	3,000
Transformers, 4.8 kv/120-240 v, 100 kva, 1 phase—6	12,000	3,000
Transformer, 4.8 kv/120 v, 500 kva, 3 phase—1	5,000	1,500
Transformers miscellaneous	12,000	10,000
Lighting	40,000	40,000
Conduit and tray system	50,000	75,000
Cable—15 kv	20,000	7,000
Cable—600 v	50,000	20,000
Cable seals	30,000	30,000
Grounding system	20,000	20,000
Communicating system	25,000	10,000
Television system	12,000	8,000

Direct current system		
Battery 125 v	20,000	3,000
Battery charger	5,000	1,500
Diesel driven generator d-c	7,000	2,500
Distribution and switching equipment	10,000	5,500
	$616,000	$291,000
*Total	$ 907,000*	
Contingencies	272,100	
Total with Contingencies	$1,179,100	

*APDA to purchase and install certain electrical equipment, estimated at $100,000. PRDC to purchase and install remainder.

[4526]

G—Other Reactor Plant Equipment and Facilities

11. *Emergency Power Supply Equipment*

This system is to act as an alternate a-c source for small essential loads such as critical sodium heating zones, fuel cask car, power, reactor building crane, etc. It is not intended to replace the normal power supply for reactor operation.

	Material	*Labor*
Diesel or gas driven a-c generator	$125,000	$12,000
Control and switchgear for a-c generator	25,000	3,000
	$150,000	$15,000
Total	$165,000	
Contingencies—30 per cent	49,500	
Total with Contingencies	$214,500	

[4527]

H—Initial Operating Supplies

1. *Neutron Source*

This is an antimony-breylium alloy placed in the bottom of the two shim rods to provide a measurable base of neutron flux required for starting up reactor.

The design of the neutron source is based on nuclear reactions taken from the Physics Section of the Reactor Handbook.

Desirable neutron flux levels were determined by NDA and APDA calculations.

Material	$18,000
Labor	2,000
Total	$20,000
Contingencies 30%	6,000
Total with Contingencies	$26,000

H—Initial Operating Supplies

2. *Initial Core Elements*

Preliminary estimates obtained by APDA from Babcock & Wilcox Co, Nuclear Metals and Batell Memorial Institute

91 Core Elements	$212,000
Escalation	21,000

Installation

Assume elements shipped disassembled, unload, handle, clean, and assemble ready for placing in reactor.

Estimate $250 ea x 91 = $ 22,750
Use $ 23,000

Material	$233,000
Labor	23,000
Total	$256,000
Contingencies 30%	76,800
Total with Contingencies	$332,800

[4528]

H—Initial Operating Supplies

3. *Initial Blanket Elements*

Preliminary estimates obtained by APDA from Babcock & Wilcox Co, Nuclear Metals and Batell Memorial Institute.

572 Blanket Elements	$343,000
Escalation	34,000

Installation

Assume elements shipped disassembled, require unloading, handling, cleaning and assembling ready for placing in reactor.

Estimate $250 ea x 572 = $143,000

Material	$377,000
Labor	143,000
Total	$520,000
Contingencies 30%	156,000
Total with Contingencies	$676,000

[4529]

H—Initial Operating Supplies

4. *Initial Sodium Inert Gas, Nak, Etc*

"This includes initial supply of sodium Argon gas and Nak." Prices obtained from Ethyl Corporation, Linde-Air Products and Delta Chemical Works.

Initial Sodium 750,000 lb @ .25	$187,500
Initial Argon gas 30,000 cu ft @ .25	7,500
Initial Nak 50,000 lb @ 1.00	50,000
Miscellaneous	5,000
	$250,000

Allowance for Unloading	15,000
Total	$265,000
Contingencies 30%	79,500
Total with Contingencies	$344,500

* APDA to purchase certain initial operating suppliers, chiefly Na and gas. PRDC to purchase, remainder.

[4530]

I—Miscellaneous Reactor Plant Equipment and Facilities

1. *Office Furniture and Equipment*

Includes desks, chairs, files etc for general plant operation.

Material	$18,000
Labor	2,000
Total	$20,000
Contingencies 15 per cent	3,000
Total with Contingencies	$23,000

[4531]

I—Miscellaneous Reactor Plant Equipment and Facilities

2. *Transportation Equipment*

Provide for general plant use one utility vehicle such as a panel or pickup truck.

Material	$5,000
Contingencies 15%	700
Total with Contingencies	$5,700

[4532]

I—Miscellaneous Reactor Plant Equipment and Facilities

3. *First Aid Equipment*

Necessary first aid equipment for treatment of minor injuries and initial treatment in case of major accident. Includes stretchers, blankets, bandages, medical supplies and instruments.

Material	$2,000
Contingencies 15%	300
Total with Contingencies	$2,300

[4533]

I—Miscellaneous Reactor Plant Equipment and Facilities

4. *Maintenance Tools and Equipment*

Necessary tools and equipment for carrying on every day plant maintenance and repair.

Consist of small tools, electrically operated hand tools and machine shop equipment such as lathes, drill press, etc.

	Material	*Labor*
Lathe	$25,000	$ 6,000
Drill Press	5,000	3,000
Milling Machine	20,000	5,000
Welding Machine	6,000	3,000
Hand Tools	19,000	500
Grinder	1,000	500
Power Saw	4,000	2,000
Total Material and Labor	$80,000	$20,000
Total	$100,000	
Contingencies 15%	15,000	
Total with Contingencies	$115,000	

[4534]

I—Miscellaneous Reactor Plant Equipment and Facilities

5. *Waste Disposal Equipment*

Equipment and facilities for holdup of radioactive waste material until sufficiently decayed for safe disposal.

Consist of holdup basin, tanks, piping, etc.

	Material	*Labor*
Earth diked hold up basin	$ 2,000	$3,000
2 hold up tanks	12,000	1,000
Piping	10,000	2,000
Total Material and Labor	$24,000	$6,000
Total	$30,000	
Contingencies 15%	4,500	
Total including Contingencies	$34,500	

[4535]

I—Miscellaneous Reactor Plant Equipment and Facilities

6. *Shipping Casks*

Lead shielded cask suitable for shipping 4 decayed elements per cask from reactor plant to Government laboratory for reprocessing.

Estimating prices obtained from American Machinery and Foundry.

Each cask with inside dimension approximately 3'-6" x 2' x 2'

	Material	*Labor*
Est each cask	$20,000	$1,000

Assume 6 casks required.

Material	6 x $20,000	= $120,000
Labor	6 x $ 1,000	= 6,000
Total		$126,000
Contingencies 15%		13,800
Total with Contingencies		$139,800

[4536]

I—Miscellaneous Reactor Plant Equipment and Facilities.

7. *Miscellaneous Systems and Power Plant Equipment*

Consists of vacuum cleaning system, compressed air, drinking and service water systems, communication and signal systems, miscellaneous hoists and cranes, portable fire protection equipment, alarm system, etc.

	Material	*Labor*
Vacuum cleaning system including vacuum cleaner, piping, valves and fittings	$ 25,000	$ 6,000
House service air compressor and piping	30,000	6,000
House service water and drinking water including pumps piping drinking fountains, etc.	45,000	10,000
Intraplant signal system including alarms, wiring, etc.	25,000	5,000
Miscellaneous portable hoists and cranes for general station use	25,000	2,000
Portable fire protection equipment	10,000	1,000
Miscellaneous allowance	35,000	5,000
Total Material and Labor	$195,000	$40,000
Total	$235,000	
Contingencies 15%	35,200	
Total including Contingencies	$270,200	

This item is the same as normally required in conventional steam plants and estimated cost is based on cost of such services in existing utility plants.

[4537]

I—Miscellaneous Reactor Plant Equipment and Facilities

8. *Cold Element Assembly Equipment*

Equipment necessary for receiving cleaning and assembly of nonradioactive elements.

Consists of cleaning equipment, work benches and tables, lathes, drill press and hand tools.

Material	$ 80,000
Labor	11,000
Total	$ 91,000
Contingencies 15%	13,600
Total with Contingencies	$104,600

[4538]

J—Construction Plant, Equipment Rental, Tools and Facilities

This item includes cost of temporary construction buildings, heating, lighting and plumbing, rental and/or purchase of construction machinery and tools, contractor's supervision and field personnel expenses and fee. Payroll insurance and taxes, welfare contribution, etc.

The allowance for this item is somewhat greater than for a conventional steam plant due to the special nature of this project and the many difficult erection problems involving heavy construction machinery, and the resulting longer construction period.

* Estimate—$2,977,000*

This is approximately 57 per cent of the total estimated labor cost of the project.

A conventional steam plant generally averages between 35 and 40 per cent of total estimated labor cost for the same items.

* In connection with its major components test program, APDA will bear a portion of these costs, estimated at $400,000.

[4539]

K—Spare Parts

To permit continuous operation spare parts are required for conventional generating plants and likewise are required for reactor plant operation.

Assume following spare parts:

2 spare control rods @ $24,300	$ 48,600
2 spare control rod actuators @ $27,600	55,200
9 spare core elements @ $2,500	22,500
25 spare blanket elements @ $700	17,500
Miscellaneous	17,200
Total	$160,000

[4540]

L—Preoperation Testing After Construction

This capital item is an expense that occurs before the plant is ready for commercial operation. It includes only operating expenses and does not include any of the costs of money or taxes other than social security taxes.

The expense is incurred after completion of the plant construction and before if becomes critical. It includes final adjustments to all plant equipment, minor changes and an item for inspection and testing of the initial loading of core and blanket elements. In addition the expense covers several weeks that are required for the progressive loading of the reactor core, carefully measuring the approach to criticality after the addition of one-third of the core ele-

ments and again after each additional element is added to the core. The hold-down plate is lowered, the reactor locked and control rods lowered after each element addition.

1. *Plant Equipment Adjustments*

(a) Supervision, operating and maintenance force of 38 men at $700 per month each for 3 months	$80,000	
(b) Allowance for minor changes and miscellaneous materials	20,000	$100,000

2. *Reactor Loading Procedure*

(a) Supervision, operating and maintenance force of 38 men at $700 per month each for 3 months	$80,000	
(b) 12 specialized men at $15,000 per year each for 3 months	45,000	
(c) Allowance for outside consulting services	25,000	
(d) Allowance for miscellaneous materials	50,000	$200,000

3. *Other Plant Operating Costs, Administration, Security and Plant Services*

(a) Administration and operating costs—10 men at $700 per month each for 6 months	$42,000	
(b) Plant services 6 months	8,000	$ 50,000
Total		$350,000

[4541]

M—Personnel Training

This allowance provides for the men that are in training to familiarize themselves with plant operating problems and supervisory duties.

2 men in supervisory training for 2 years @ $12,500 each	$ 50,000
10 men in operation training for 2 years @ $10,000 each	200,000
20 men in operation training for 1 year @ $10,000 each	200,000
20 men in operation training for ½ year @ $10,000 each	100,000
Total	$550,000

Note: Portions of this training will be at operating reactor plants, schools and classes conducted by APDA and PRDC.

[4542]

N—Initial Operation Low to Full Load

This allowance provides for the cost of one year's operation that is required to bring the reactor to a condition of safe operation at full load. After the reactor becomes critical it is loaded to give a small heat output and the control and safety rods operated to determine their effectiveness. These tests are repeated many times in the process of calibrating control rods and proving that the safety rod characteristics are satisfactory.

After these tests which require several months, other tests estimated to take about 6 months will be performed. These tests required to prove reactor stability include a long series of tests with oscillating reactivity applied to the reactor core with programmed reactor loadings and oscillator frequencies.

The estimate for the year's testing includes:

1. *Labor*

10 men @ $15,000	$150,000	
10 men @ 10,000	100,000	$250,000

2. *Material and Testing*

(a) Purchase 10 special test core elements @ $5,000 ea	50,000	
(b) Examination of above in outside laboratories after irradiation	100,000	
(c) Miscellaneous chemical tests of reactor fluids by outside laboratories	25,000	
(d) Plant services	25,000	200,000
3. *Consulting Service Allowance*		100,000
Total		$550,000

[4543]

O—Interest During Construction

Interest is estimated on basis of Loan Agreements for $15,000,000 to be borrowed during the construction period.

$1,800,000

See Arthur Anderson calculation in connection with cash flow study.

[4544]

P—Engineering Services and Expenses

This figure represents estimated costs of engineering services and expenses of Commonwealth Associates Inc. in preparing construction drawings, specifications, purchasing and other special services required by PRDC.

Estimated Cost—$900,000*

* In connection with its major components test program, APDA will bear a portion of these costs, estimated at $150,000.

[4545]

Q—Local Taxes

Local taxes have been estimated from tax data obtained from the township supervisor and from State Tax Commission Manual and is based on a tax rate of $44.18 per $1,000 per year of accumulated value of the property. Taxes are included in the estimate until 1960 when reactor plant goes into operation.

Estimated Taxes—$519,200

[4546]

R—Working Capital

A Task Committee on Fixed Charges and Financing was appointed by E. W. Morehouse to review electric utility experience and recommend ground rules for use in making economic analyses. R. F. Brower was chairman of the Task Committee. Based on their recommendations the Economics Committee determined that working capital should be a part of the plant investment and should be equal to 4 per cent of the estimate. This is verified in minutes of the Economics Committee meeting of July 22, 1954.

The working capital figure of $1,175,000, shown in the PRDC Estimate is taken without change from an earlier plant estimate of $30,496,000 made by APDA and is 4 per cent of the APDA estimate.

[4557]

EXHIBIT ACKER 10

(Back-up Material for Operation Period Cash Flow Schedules)

COMPUTATION SHEET SHOWING DERIVATION OF CASH APPLICATION

Lines 5-13, Sched No. 1, Exhibit

Costs in Thousands of Dollars

Reference Line In Exhibit Schedule No. 1	Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	Reference Authority
Lines 5	PRODUCTION COSTS											
	Operation											
	Labor, based on Manning Table (59 men) and 1956 labor costs escalated at 4%, compounded annually.	539	555	576	597	649	674	699	725	752	781	
	Material, estimated no escalation, includes make-up Na, Inert Gas Make-up, Lubricants, etc.	160	160	160	160	160	160	160	160	160	160	
	Sub Total	695	715	736	757	809	834	859	885	912	941	APDA, J Manna
	Maintenance											
	Labor, based on Manning Table (9 men) and 1956 labor costs escalated at 4%, compounded annually.	146	154	161	169	178	186	195	205	215	225	
	Material, estimated with no escalation, Piping, Valves Small Parts, Maintenance Supplies, etc.	232	232	232	232	232	232	232	232	232	232	
	Sub Total	378	386	393	401	410	418	427	437	447	457	APDA, J Manna
	General Administrative Overheads											
	Administrative Staff, Rent, etc.	70	70	70	70	70	70	70	70	70	70	APDA, J Manna
	Auxiliary Services											
	Costs derived from Services Contract and includes compressed air, heating steam, general service water, city water and sewage. Computation attached.	49.7	50.3	50.9	51.5	52.2	52.8	53.5	54.2	54.8	55.4	D.E.Co., J. Hart
	Auxiliary Power											
	Computed from power consumption estimates made by APDA Economics Group using a 10 Mill per Kwhr Power Cost.	280	315	552	552	631	684	638	729	729	729	D.E.Co., J Hart
Line 5	Total, Production Costs	1472.7	1536.3	1801.9	1831.5	1977.2	2063.8	2052.5	2180.2	2217.2	2257.4	

DEH/bhh
February 26, 1957

Reference Line In Exhibit Schedule No. 1	Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	Reference Authority
Line 6.	CORE PROCESSING COSTS											
	Aqueous processing											
	Process throughput, kg/yr Cost is derived from a charge of $102.00 per kg.											
	Clean-up Time at $15,300 per day											
	Convert U Salts to Metal Cost is derived from a charge of $35 for UNH conversion to UF_6 and $70 for UF_6 conversion to metal per KG of throughput.											
	Convert PU Salts to Metal											
	Core PU throughput, kg/yr Cost is derived from a charge of $1500 per kg of PU throughput.											Throughput Quantities by APDA, W. N. McDaniels. Process Costs derived from Chicago Operations Office, USAEC, Teletype Feb. 25, 1957.
	Scrap Recovery Costs Cost is derived from a charge of $67.50 per kg based on 20 per cent of process throughput.											
Line 6.	Total, Core Processing Costs	778	742	757	849	840	782	725	749	794	795	
Line 7.	BLANKET PROCESSING COSTS											
	Aqueous processing											
	Process throughput, kg/yr cost is derived from a charge of $15.30 per kg of throughput.											Throughput Quantities by APDA, W. N. McDaniels. Process Costs derived from Chicago Operations Office, USAEC, Teletype February 25, 1957.
	Clean-up Time $15,300 per day											
	Convert PU Salts to Metal											
	Blanket PU throughput, kg/yr Cost is derived from a charge of plutonium throughput											
	Storage Drum Cost											
Line 7.	Total, Blanket Processing	235	261	345	431	556	717	713	728	762	761	

ben/ohh
February 28, 1957

Reference Line In Exhibit Schedule No. 1	Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	Reference
Line 8	ADDITIONAL FUEL CYCLE COSTS											
	Core Shipping											
	Cost is derived from a charge of $20 per Kg of core process throughput											APIA, J. Hanna
	Blanket Shipping											
	Cost is derived from a charge of $1 per kg of blanket process throughput											APIA, J. Hanna
	Core Fabrication											
	Core elements fabricated per yr.	161	110	175	174	167	149	149	164	164	164	APIA, J. Hanna
	Cost is derived from a charge of $2000 per element including axial blanket	322	220	350	348	334	298	298	328	328	328	APIA, J. Hanna
	Blanket Fabrication											
	Blanket elements fabricated per yr.	101	131	199	247	236	265	354	407	407	407	APIA, J. Hanna
	Cost is derived from a charge of $600 per element	61	79	119	148	142	159	212	244	244	244	APIA, J. Hanna
	Core Material Replacement											
	U 235 destroyed, kg per yr											APIA, J. Hanna
	Cost is derived from a charge of $16.40 per gram of U 235 destroyed											AEC
	Blanket Material Replacement											
	Depleted U replacement, kg per yr.											APIA, J. Hanna
	Cost is derived from a charge of $2.60 per kg of depleted U replacement											AEC
	Control Poison Replacement											
	Estimated Cost	2	2	4	4	4	5	4	5	5	5	APIA, J. Hanna
	Special Material Rental											
	Kg of U 235 inventory				1111	1077	909	965	1033	1033	1033	APIA, J. Hanna
	At interest on inventory valued at 16.40 per gm	---	---	---	---	707	614	633	679	678	678	AEC
Line 9	Total, additional fuel cycle costs	1,202	1,294	1,832	2,297	3,216	3,[illegible]	3,361	3,532	3,677	3,677	

Reference Line In Exhibit Schedule No. 1	Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	Reference Authority
Line 9	Property Taxes											
	Plant cost less working capital assessed at 50% with tax rate at $44.18 per $1000. Tax rate provided by Frenchtown Township $31,225,000 x 0.50 x $44.18 per $1000.	690	690	690	690	690	690	690	690	690	690	Frenchtown Township and J Hanna
Line 10	Insurance, 0.5% on plant cost less working capital and operation in test year	149	149	149	149	149	149	149	149	149	149	and J.Hanna
Line 11	Interest on Long-term bank loan 4.35% on balance	652	653	652	587	500	414	326	239	153	33	Loan Agreement
Line 13	Payment of Principal on Long-term bank loan	---	---	---	2000	2000	2000	2000	2000	2000	3000	Loan Agreement

D&H/bnh
February 13, 1957

(Revised February 28, 1957)

[illegible] PLANT [illegible]

Item	Number of Men: S	Hr	Shift	Total	Salary	Base Plus Benefits 15%-Salary 30%-Hourly	Total Payroll Expense Less Labor Cost Level
Direct Op							
(a) Administration and Technical							
1. Plant Superintendent	x		1	1	13,500	15,525	15,525
2. Asst. Plant Superintendent	x		1	1	11,500	13,225	13,225
3. Engineering Assistant	x						
4. Secretary	x		1	1	4,500	5,175	5,175
5 Clerk	x		3	3	5,000	5,750	17,250
6. Plant Cleaner		x	1	1	3,600	4,680	4,680
7. Chief Security Officer	x		1	1	5,800	6,670	6,670
8. Leader-Security Officer	x		1	3	4,800	5,520	16,560
9. Security Guard		x	3	14	4,000	5,200	72,800
10. Chief Chemist	x		1	1	10,000	11,500	11,500
11 Asst Chemist	x		1	1	8,000	9,200	9,200
12. Health Physicist	x		1	4	7,000	8,050	32,200
13. Nurse	x		1	1	5,000	5,750	5,750
Subtotal				32			210,535
(b) Plant Operating Force							
14. Shift Supervisor	x		1	4	9,700	11,155	44,620
15. Control Operator	x		1	5	7,000	8,050	40,250
16. Auxiliary Operator		x					
17 Reactor Operator		x	2	9	6,500	7,480	67,320
18. Fuel Handling and Refabrication		x	2	9	6,500	8,450	76,000
Subtotal				27			228,190
(c) Plant Maintenance							
19. Maintenance Supervisor	x		1	1	10,000	11,500	11,500
20. Instrument Technician	x		2	2	6,500	7,475	14,950
21 Mechanic		x	1	1	6,000	7,400	7,800
22. Electrician		x	1	1	6,000	7,800	7,800
23. Pipe fitter		x	1	1	6,000	7,800	7,800
24. Helper		x	3	3	5,000	6,500	19,500
					Total Base	Total Benefits	
25 Roving Maintenance				(added)	34,000	11,650	50,650
Subtotal				9			120,000
Total Plant Personnel				68			558,725

Sample Computation Showing 1961 Costs

Administration Technical and Operation Labor Cost = $438,725 x (1.04)^5 = $535,000 Assume 4% escalation, compounded annually

Maintenance Labor Force = $[illegible] x (1.04)^5 = $[illegible] Assume 4% escalation, compounded annually

[illegible]/emr

CALCULATION OF STEAM REVENUE

REFER TO EXHIBIT SCHEDULE N 1, LINE NO 1

Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Net Plant Capability, Kw	103,830	103,830	127,320	127,320	142,620	155,000	155,000	155,000	155,000	155,000
Availability Factor	0.40	0.45	0.70	0.70	0.75	0.75	0.70	0.80	0.80	0.80
Kilowatt Days (1000)	15,150	17,040	32,590	32,590	39,100	42,480	39,700	45,260	45,260	45,260
Labor, M, $/Hr	3.81	3.96	4.12	4.28	4.45	4.63	4.81	5.00	5.20	5.41
Fuel, F, cents/10^6 Btu	35.3	36.4	37.5	38.6	39.8	41.0	42.2	43.5	44.8	46.1
Net Megawatt Hours	363,700	408,800	782,000	782,000	938,000	1,020,000	952,000	1,086,000	1,086,000	1,086,000

Steam Revenue Components

Capacity Charge	0	$ 155,600	$1,157,000	$ 850,500	$1,181,500	$1,453,000	$1,466,000	$1,484,000	$1,500,000	$1,519,000
Readiness to Serve	114,000	132,400	261,000	268,500	332,300	376,500	348,000	421,000	433,600	446,100
Energy Charge	1,076,500	1,249,000	2,460,000	2,530,000	3,130,000	3,508,000	3,368,000	3,962,000	4,081,400	4,200,000
Total	$1,191,000	$1,537,000	$3,878,000	$3,649,000	$4,644,000	$5,338,000	$5,182,000	$5,867,000	$6,015,000	$6,165,000

DEH/bbh
February 13, 1957

(Revised February 28, 1957)

[4563]

ILLUSTRATION OF COMPUTATION PROCEDURE USED TO DERIVE STEAM REVENUE

Capacity Charge (C.C.)

$$C.C. = 8.55 (R + M_1) \left(\frac{A-0.40}{0.30}\right) (C)$$

Where

R = 0.80, years 1 thru 3

$R = 2.14 - 1.34 \times \frac{155,000}{C}$, years 4 thru 10

$M_1 = 0.20 \times \frac{M}{3.14}$, M equals manhour rate in year of consideration

A = Availability factor. When equal to or greater than 0.70 the fraction equals 1. When equal to or less than 0.40 the fraction equals zero.

C = Plant Capability

Substituting in the above equation

$$\text{Capacity Charge} = 8.55 \left[R + \left(.20 \times \frac{M}{3.14}\right)\right] \left[\frac{A-0.40}{0.30}\right] \left[C\right]$$

Year 1961

$$C.C. = 8.55 \left[.80 + \left(.20 \times \frac{3.81}{3.14}\right)\right] \left[\frac{0.40-.40}{.30}\right] \left[103,830\right]$$

$$= 8.55 \left[.80 + .243\right] \left[0\right] \left[103,830\right]$$

$$= 0$$

Year 1962

$$C.C. = 8.55 \left[.80 + \left(.20 \times \frac{3.96}{3.14}\right)\right] \left[\frac{.45-.40}{.30}\right] \left[103,830\right]$$

$$= 8.55 \left[.80 + .252\right] \left[.168\right] \left[103,830\right]$$

$$= 8.55 \left[1.052\right] \left[.168\right] \left[103,830\right]$$

$$= \$155,600$$

Year 1963

$$C.C. = 8.55 \left[.80 + .20 \times \frac{4.12}{3.14}\right] \left[\frac{.70 - .40}{.30}\right] \left[127,320\right]$$

$$= 8.55 \left[1.063\right] \left[1\right] \left[127,320\right]$$

$$= \$1,157,000$$

Year 1964

$$C.C. = 8.55\left[2.14 - 1.34\left(\frac{155,000}{C}\right) + \left(.20 \times \frac{M}{3.14}\right)\right]\left[\frac{A-.40}{.30}\right]\left[\text{Plant Capability}\right]$$

$$= 8.55\left[2.14 - 1.34\left(\frac{155,000}{127,320}\right) + \left(.20 \times \frac{4.28}{3.14}\right)\right]\left[\frac{.70-.40}{.30}\right]\left[127,320\right]$$

$$= 8.55\left[2.14 - 1.63 + .273\right]\left[1\right]\left[127,320\right]$$

$$= \$850,500$$

Year 1965

$$C.C. = 8.55\left[2.14 - 1.34\left(\frac{155,000}{142,620}\right) + \left(.20 \times \frac{4.45}{3.14}\right)\right]\left[\frac{.75-.40}{.30}\right]\left[142,620\right]$$

$$= 8.55\left[2.14 - 1.455 + .283\right]\left[1\right]\left[142,620\right]$$

$$= 1,181,500$$

Year 1966

$$C.C. = 8.55\left[2.14 - 1.34\left(\frac{155,000}{155,000}\right) + \left(.20 \times \frac{4.63}{3.14}\right)\right]\left[\frac{.75-.40}{.30}\right]\left[155,000\right]$$

$$= 8.55\left[2.14 - 1.34 + .295\right]\left[1\right]\left[155,000\right]$$

$$= \$1,453,000$$

Years 1967 thru 1970

Repeat year 1966 procedure using appropriate numbers from attached schedule.

Readiness-to-Serve (R)

$$R = \$.0066\ (M_2 + F_2) \quad \text{(Kilowatt days)}$$

Where

$M_2 = 0.03 \times \frac{M}{\$3.14}$; M equals manhour rate in year of consideration

$F_2 = 0.97 \times \frac{F}{\$0.31}$; F is the average fuel cost per million Btu of Edison's steam production system

Substituting in the above formula

$$R = \$.0066 \left[\left(.03 \times \frac{M}{3.14}\right) + \left(.97 \times \frac{F}{0.31}\right) \right] \left[\text{Kilowatt days} \right]$$

Year 1961

$$R = \$.0066 \left[\left(.03 \times \frac{3.81}{3.14}\right) + \left(.97 \times \frac{.353}{.31}\right) \right] \left[15,150,000 \right]$$

$$R = \$.0066 \left[.0364 + 1.105 \right] 15,150,000$$

$$= \$114,000$$

Year 1962

$$R = \$.0066 \left[\left(.03 \times \frac{3.96}{3.14}\right) + \left(.97 \times \frac{.364}{.31}\right) \right] (17,040,000)$$

$$= \$132,600$$

Year 1963

$$R = \$.0066 \left[\left(.03 \times \frac{4.12}{3.14}\right) + \left(.97 \times \frac{.325}{.31}\right) \right] (32,590,000)$$

$$R = \$261,000$$

Years 1964 thru 1970

Calculated in a similar manner using appropriate values from attached schedule.

Energy Charge (E)

$$E = .0026 \times \frac{F}{\$0.31} \times \text{Net Kilowatt hours}$$

Where

F = the average fuel cost per million Btu of Edison's steam production system

Year 1961

$$E = .0026 \times \frac{.353}{.31} \times 363,700,000$$

$$= \$1,076,500$$

Year 1962

$$E = .0026 \times \frac{.364}{.31} \times 408,800,000$$

$$E = \$1,249,000$$

Years 1963 thru 1970

Computed in a similar manner using appropriate values from attached schedule.

NOTE: Factor F is the cost of fuel escalated 3% compounded annually using a 1956 base figure of 30.5 cents per million Btu.

Factor M is the manhour rate escalated 4% compounded annually using a 1956 base figure of $3.14/hr.

DEH/bhh/emr
2-13-57

Reference Line In Exhibit Schedule No. 1		1969	1970	Reference Authority
Line 8	ADDITIONAL FUEL CYC			
	Core Shipping			
	Cost is derived charge of $20 p core process th			APDA, J. Hanna
	Blanket Shipping			
	Cost is derived charge of $1 pe blanket process			APDA, J. Hanna
	Core Fabrication			
	Core elements f per yr.	164	164	APDA, J. Hanna
	Cost is derived charge of $2000 including axi	328	328	APDA, J. Hanna
	Blanket Fabricati			
	Blanket elements per yr.	407	407	APDA, J. Hanna
	Cost is derived charge of $60(	241	245	APDA, J. Hanna
	Core Material Repl			
	U 235 destroyed, Cost is derived charge of $16.40 of U 235 destr			APDA, J. Hanna
				AEC
	Blanket Material R			
	Depleted U repla kg per yr.			APDA, J. Hanna
	Cost is derived charge of $2.50 depleted U repla			AEC
	Control Poison Repl			
	Estimated cost	5	5	APDA, J. Hanna
	Special Material Re			
	Kg of U 235 inven & interest on in valued at 16.40	1033	1033	APDA, J. Hanna
		678	678	AEC
Line 9	Total, additional cycle costs	3677	3677	

DEH/bhh/emr
February 28, 1957

CALCULATION OF PLUTONIUM RESERVE

Refer to Exhibit XLII, Revised, Schedule No. 1, Line No. 7

YEAR	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	Reference Authority
erating Data											
Reactor Power Level, mw Heat	300	300	350	350	400	430	430	430	430	430	
Load Factor	0.40	0.45	0.70	0.70	0.75	0.75	0.70	0.80	0.80	0.80	
Reactor Output, mw yrs.	120	135	245	245	300	329	301	344	344	344	
Burn-up, Per cent	1.0	1.5	2.0	2.0	2.5	3.0	3.0	3.0	3.0	3.0	AFDA, J. Manna
Plutonium Production											
Gross Production, kg.yr.											
Net Production, kg.yr. Deduct 1% loss											
Plutonium Unit Price, $ Per gm.											(AEC schedule of prices and charges, letter, Jan. 5, 1955 (Classification status (Confidential
Plutonium Revenue, $1000	1383	1864	2987	4076	5526	6228	6313	6497	6888	6861	
TOTAL										48673	AFDA, J. Manna

[4567]

4567

COMPUTATION OF ANNUAL CHARGES FOR AUXILIARY SERVICES

BASED ON SERVICES CONTRACT

INCLUDED IN "PRODUCTION COSTS" EXHIBIT SCHED NO. 1, LINE 5

Building Heat Charge
Rate Structure:

Demand Charge: $0.45 per yr per pound.

Consumption Charge: $0.85 per 1000

Fuel adjustment: 1.0 cents per 1000 pounds of steam consumed for each full 8 cents increase in the cost of fuel above 65 cents per million BTU

COMPUTATION OF BUILDING HEAT CHARGE

Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Fuel Adjustment	40 cents	44 cents	48 cents	52 cents	56 cents	60 cents	64 cents	68 cents	73 cents	77 cents
Base price	85 cents	85 cents	85 cents	85 cents	85 cents	85 cents	85 cents	85 cents	85 cents	85 cents
Total Rate	1.25	1.29	1.33	1.37	1.41	1.45	1.49	1.53	1.58	1.62
*1 Consumption Charge	$19,625	20,225	20,825	21,425	22,125	22,725	23,425	24,125	24,725	25,325
*2 Demand Charge	7,200	7,200	7,200	7,200	7,200	7,200	7,200	7,200	7,200	7,200
Total	$26,825	27,425	28,025	28,625	29,325	29,925	30,625	31,325	31,925	32,525

*1 Based on an annual consumption of 15,700,000 # of steam
*2 Based on 16,000 #/Hr demand

Potable Water Charge
Rate Structure:

Service Charge: $1,425.00 per month
Consumption Charge: 10 cents per 1000 gal

COMPUTATION OF POTABLE WATER CHARGE

Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Service Charge	$17,100	$17,100	$17,100	$17,100	$17,100	$17,100	$17,100	$17,100	$17,100	$17,100
Consumption Charge*	400	400	400	400	400	400	400	400	400	400
Total	$17,500	$17,500	$17,500	$17,500	$17,500	$17,500	$17,500	$17,500	$17,500	$17,500

*Based on 4,000 M Gal per yr.

DEH/bhh
February 13, 1957

(Revised February 28, 1957)

Computation of annual Charges for Auxiliary Services
Based on Services Contract (Cont'd)

General Service Water Charge
Rate Structure:

Service Charge: $125 00 per month for first 1000 GPM
$10.00 per month per 100 gpm for next 2,000 gpm.

Consumption Charge: 0 1 cents per 1000 gal.

COMPUTATION OF GENERAL SERVICE WATER CHARGE

Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Service Charge	$3,900	$3,900	$3,900	$3,900	$3,900	$3,900	$3,900	$3,900	$3,900	$3,900
Consumption Charge*	1,025	1,025	1,025	1,025	1,025	1,025	1,025	1,025	1,025	1,025
	$4,925	$4,925	$4,925	$4,925	$4,925	$4,925	$4,925	$4,925	$4,925	$4,925

* 1,025,000 M Gal per yr usage.

Compressed Air Charge
Rate Structure:

Minimum Charge: $37 50 per month, 100 CFM contract demand

Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Minimum charge	$450	$450	$450	$450	$450	$450	$450	$450	$450	$450

Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Total auxiliary Services Cost	$49,700	$50,300	$50,900	$51,500	$52,200	$52,800	$53,500	$54,200	$54,800	$55,400

DRH/bhh
February 13, 1957

(Revised February 28, 1957)

LOCAL PROPERTY TAX CALCULATION

Frenchtown Township Supervisor Furnished Tax Rate.

ITEM 9

TAX YEAR	1957	1958	1959	1960
1956 Material & Labor	735,000	735,000	735,000	735,000
1956 Construction Plant	75,000	75,000	75,000	75,000
1957 Material & Labor		5,005,000	5,005,000	5,005,000
1957 Construction Plant		550,000	550,000	550,000
1958 Material & Labor			8,110,000	8,110,000
1958 Construction Plant			775,000	775,000
1959 Material & Labor				6,357,900
1959 Construction Plant				1,202,000
TOTAL	810,000	6,365,000	15,250,000	25,409,900
	$\frac{810,000}{4} \times \frac{44.18}{1000}$ =	$\frac{6,365,000}{4} \times \frac{44.18}{1000}$ =	$\frac{15,250,000}{4} \times \frac{44.18}{1000}$ =	$\frac{25,409,900}{4} \times \frac{44.18}{1000}$ =
TAX BY YEAR, Payable as of January 1.	8,924.36	70,290.38	168,414.16	271,631.36

SUMMARY:

1957	8,924.36
1958	70,290.38
1959	168,414.16
1960	271,631.36
	519,260.26

[4570]

4570

[4573]

Exhibit Acker 12

(LETTERS OF PRDC MEMBERS WAIVING REGULATORY AGENCY APPROVALS AS CONDITION UPON CONTRIBUTION TO PRDC; ONLY ONE SAMPLE PRINTED.)

ALABAMA POWER COMPANY
Birmingham 2, Alabama

December 27, 1956

Received
Dec 31 1956
P. R. D. C.

Power Reactor Development Company
1911 First Street
Detroit 26, Michigan

Gentlemen:

By letter dated October 23, Alabama Power Company agreed to contribute to Power Reactor Development Company the sum of $160,000 per year for five years, commencing with the year 1956, subject to call by Power Reactor Development Company. This commitment was made subject to the obtaining by the Company of satisfactory approval and consent of any public regulatory agencies having jurisdiction. We deem it unnecessary to obtain Commission approval and, therefore, waive the condition of our commitment letter providing for satisfactory approval and consent of regulatory agencies.

Yours very truly,

ALABAMA POWER COMPANY

By WALTER BOULL
Executive Vice President

WB/w

[4594]

Exhibit Acker 13

(ORDERS OF REGULATORY COMMISSIONS WITH RESPECT TO GUARANTEE AGREEMENTS AND CONTRIBUTIONS; ONLY ONE SAMPLE PRINTED)

ROCHESTER GAS AND ELECTRIC CORPORATION
East Avenue, Rochester, N. Y.

R G.and E
(Names Illegible)

RWH Feb 26 1956
Telephone
LOcust 2-7000

February 25, 1957

Received
Feb 29 1957
P. R. D. C.

Mr. Robert W. Hartwell,
General Manager,
Power Reactor Development Company,
1911 First Street,
Detroit, Michigan.

Re: Bank Loan Guaranty.

Dear Mr. Hartwell:

I am pleased to send you herewith two copies of an Order issued by the New York State Public Service Commission on February 18, 1957 authorizing this Company to execute a Guaranty Agreement covering 1.80% of the principal amount ($15,000,000) of the loan negotiated with

the five New York banks by the Power Reactor Development Company.

This will also confirm to you our waiver of the condition with respect to regulatory agency's approval set forth in our letters of February 1, 1957 and October 30, 1957 in connection with our commitment to make contributions to the Power Reactor Development Company.

Very truly yours,

R. E. GINNA,
ROBERT E. GINNA,
President.

REG:MP
Encls.

[4595]

STATE OF NEW YORK
PUBLIC SERVICE COMMISSION

At a session of the Public Service Commission held in the City of New York on February 18, 1957.

Received 2/22/57
REG

COMMISSIONERS PRESENT
Benjamin F. Feinberg, Chairman
Spencer B. Eddy
Glen R. Bedenkapp
Francis T. Mylott
Richard H. Balch
Aaron L. Jacoby

CASE 18122—Petition of Central Hudson Gas & Electric Corporation, Long Island Lighting Company, and Rochester Gas and Electric Corporation for authority to exe-

cute an agreement guaranteeing notes to be issued by Power Reactor Development Company.

* * * * *

A joint petition having been filed November 14, 1956, by Central Hudson Gas & Electric Corporation, Long Island Lighting Company and Rochester Gas and Electric Corporation for authority to execute a guaranty agreement, substantially in the form of Annex C to Exhibit A attached to the petition, under which petitioners would severally guarantee payment when due of a percentage, as provided in said agreement, of the principal of and interest on notes to be executed by Power Reactor Development Company, a nonprofit membership corporation organized and existing under the laws of the state of Michigan, the proceeds from such notes to be used by Power Reactor Development Company, together with other funds, to design, construct and operate one or more experimental nuclear power reactors, and public hearing after due notice having been held, and the Commission having determined that, subject to the conditions hereinafter stated and not otherwise, participation by petitioners as proposed in such experimental project is in the public interest and that the execution by petitioners of said guaranty agreement is reasonably required for such purpose, and that any payments made by petitioners under or in pursuance of said agreement will be chargeable to operating expenses, it is

[4596]

ORDERED

1. That Central Hudson Gas & Electric Corporation, Long Island Lighting Company, and Rochester Gas and

Electric Corporation be and they hereby are authorized to execute and issue, not later than April 1, 1957, a guaranty agreement substantially in the form of, and in amounts of principal and interest not in excess of those specified in, Annex C to Exhibit A attached to the petition herein.

2. That within ten days after execution and issuance of the guaranty agreement as herein authorized, each of the said petitioners shall file a verified report thereof in conformity with the Commission's order in Case 6422.

3. That within ten days after execution and issuance of the guaranty agreement as herein authorized, a certified copy thereof in the form as executed shall be filed on behalf of petitioners.

4. That any payments made by petitioners, or any of them, under or in pursuance of said agreement shall be charged to Account 801—Miscellaneous General Expenses.

5. That this order shall be without force or effect until there has been filed with this Commission unconditional acceptances by Central Hudson Gas & Electric Corporation, Long Island Lighting Company, and Rochester Gas and Electric Corporation agreeing to obey all of the terms, conditions and requirements of this order, and that if such acceptances are not filed within a period of twenty days from the date of service of this order, this order shall be null and void.

By the Commission.

[SEAL] [SIGNED] ALTON G. MARSHALL,
Secretary.

HTO'B LM

[4597]

STATE OF NEW YORK
PUBLIC SERVICE COMMISSION

CASE 18122—Petition of Central Hudson Gas & Electric Corporation, Long Island Lighting Company, and Rochester Gas and Electric Corporation for authority to execute an agreement guaranteeing notes to be issued by Power Reactor Development Company.

APPEARANCES:

Kent H. Brown, Counsel (by Barbara M. Suchow and Morton L. Simons, Assistant Counsel), for the Public Service Commission.

David K. Kadane, 250 Old Country Road, Mineola, N. Y., General Counsel, Long Island Lighting Company and other petitioners herein.

Gould & Wilkie (by M. S. Lockhart of counsel), 1 Wall Street, New York City, attorneys for Central Hudson Gas & Electric Corporation.

Robert E. Ginna, President, Rochester Gas and Electric Corporation, 89 East Avenue, Rochester, N. Y.

T. J. BRADY, Examiner:

This proceeding is upon a joint petition filed by Central Hudson Gas & Electric Corporation, Long Island Lighting Company and Rochester Gas and Electric Corporation for authority, pursuant to Section 69 of the Public Service Law, to execute an agreement whereby each of the petitioners would guarantee a certain percentage of notes aggregating $15,000,000, payable to a group of banks by Power Reactor Development Company (PRDC).

PRDC was organized in August, 1955 under the Membership Corporation Law of the State of Michigan, as a non-profit corporation, having no shares of stock. The petitioners herein are and have been participating in the nuclear power project of PRDC, which was organized for the purpose of advancing the art and technology of the production of heat energy through the use of fissionable materials for the generation of electric power. This project was conceived in response to the provisions of the Atomic Energy Act of 1954, which encouraged civilian participation in the development of atomic energy for peacetime purposes.

The Securities and Exchange Commission ruled, on January 18, 1957, that PRDC was not to be considered an electric utility company for the purposes of the Public Utility Holding Company Act of 1935.

[4598]

Associated with PRDC in this project is an organization known as Atomic Power Development Associates (APDA), a non-profit company organized under the laws of New York State. Its principal purpose is to conduct studies and research as to economic methods of producing and utilizing nuclear materials and atomic energy, primarily for the generation of electric power, and also for such other industrial and commercial applications as appear to be of practical value. APDA designed the reactor which PRDC now proposes to construct and operate.

Mr. Ernest R. Acker, who is president, general manager and a director of Central Hudson, testified in support of

the petition herein, and characterized APDA as "the research and design organization" and PRDC as "the constructing organization to go through with completion of the project".

The three petitioners herein are members of APDA and PRDC.

The membership of PRDC consists of 21 corporations, of which seven are industrial corporations, 13 are operating electric utility corporations, and one is a service corporation (Southern Services, Inc.), representing four operating electric corporations and their holding company (The Southern Company). There is no written instrument evidencing membership. None of the net earnings of PRDC may inure to the benefit of any member corporation and, upon dissolution, any remaining assets must be contributed to a scientific or educational institution for the promotion of the same aims and purposes for which PRDC was formed.

The plant which PRDC now has under construction is known as the Enrico Fermi Atomic Power Plant, located at Lagoona Beach, Michigan, on Lake Erie. It is described as a fast neutron breeder reactor. It will produce both steam and plutonium and, in the process, will actually produce more fissionable material than it consumes, according to Mr. Acker. The plant is designed to have a nominal steam capacity equivalent to 100,000 kw of electricity, but it is expected that it will actually produce steam equivalent to 150,000 kw of electrical capacity, and the turbine generating plant to be built adjacent to the reactor by Detroit Edison Company will have that rated capacity. Construction is expected to be

completed by December, 1959, after which there will be a year of testing followed by ten years of operation.

All of the steam produced at the reactor will be purchased by Detroit Edison and all of the plutonium will be purchased by the United States Government at prices to be fixed by it.

The total cost of construction of the project is estimated to be $43,216,000. This is to be financed by direct money contributions by the member corporations, aggregating $23,540,000, bank loans totaling $15,000,000, and contributions of services by APDA valued at $7,000,000. Thus, the total financial resources to be made available to PRDC amount to $45,540,000. The excess over construction cost is to be used as working capital.

The three petitioners herein have committed themselves to make direct contributions to PRDC in the following amounts:

Central Hudson	$200,000
Rochester	$450,000
Long Island	$620,000

These contributions are payable over a five-year period and are not refundable. As of the date of the hearing in this matter, Central Hudson had already contributed $20,000, Long Island had contributed $62,000, and Rochester was expected to make its initial contribution of 10 per cent of its commitment very shortly thereafter. The record indicates that in accounting for these expenditures the companies have charged them directly to Account 801—Miscellaneous General Expenses, an operating expense

account. This treatment is in accordance with the provisions of the Uniform System of Accounts. Since these amounts are not large in relation to the operations of the petitioners, it is expected that the contributions will be charged off in the year in which they are made, so that there will be no deferral in accounting therefor.

According to Mr. Acker, arrangements have been concluded whereby PRDC is to borrow $15,000,000 from certain banking institutions. Because PRDC is a new corporation with no credit standing and because of the many uncertainties as to

[4600]

the future operation of this research and developmental project, it was necessary for certain member corporations of PRDC to agree to guarantee stated percentages of the loans. These guarantees cover both principal and interest. The member corporations and the respective percentages of the loans to be guaranteed by them are as follows:

Central Hudson Gas & Electric Corporation	.80%
The Cincinnati Gas & Electric Company	1.00
Columbus and Southern Ohio Electric Company	1.00
Consumers Power Company	10.00
Delaware Power & Light Company	1.20
The Detroit Edison Company	58.84
Iowa-Illinois Gas and Electric Company	.48

Long Island Lighting Company	2.48
Philadelphia Electric Company	10.00
Potomac Electric Power Company	3.20
Rochester Gas and Electric Corporation	1.80
The Southern Company	8.00
Wisconsin Electric Power Company	1.20

The record indicates that, if and when the petitioners herein are required to make good on their guarantees (which eventuality is not anticipated), they will account for the expenditures in the same manner as they are now treating their contributions, that is, by charging such expenditures to operating expense Account 801.

Of course, if the petition is granted, the petitioners would have to show on their balance sheets, by notation or otherwise, the contingent liability which would be created by their undertaking to guarantee a portion of the notes to be issued by PRDC.

The record indicates that no attempt has been made to collect or segregate the costs representing the time and expenses of the officers and employees of the petitioners working on the PRDC project, attending meetings, etc. The amounts involved are probably not large but, as a matter of proper accounting, all expenditures incurred by the petitioners in connection with this project should be reported in a special sub-account of Account 801, and clearly set forth in their annual reports to this Commission.

Conclusions and Recommendation

On the basis of the record in this proceeding, it is concluded that the execution of the guarantee agreement would constitute evidence of indebtedness within the meaning of Section 69 of the Public Service Law, and the petitioners properly brought this matter before the Commission for its approval.

These companies, and public utilities generally, have a responsibility to participate in research and developmental work aimed at the eventual commercial use of nuclear materials for the generation of electricity and the desire of the petitioners to take part in a program such as PRDC has undertaken is commendable and in the public interest.

It is therefore recommended that the joint petition of Central Hudson Gas & Electric Corporation, Long Island Lighting Company, and Rochester Gas and Electric Corporation for authority to execute a guarantee agreement in the form appended to the petition as Annex C thereto, be granted.

February 6, 1957

TJB:DH

APPROVED BY THE COMMISSION FEB 18 1957

[4731]

Exhibit Acker 20

SUMMARY OF MATERIAL ON ORDER

Acker Exh. #7

No.	Item	Proposal From	On Order By	Estimated Amount Without Contingencies (Acker Exh. #7)	Order Amount
B-2	Containment Vessel	Chicago Bridge & Iron Co. Dec. 24, 1956	PRDC	$555,700	$555,700
B-3	Hold-down Plate and Actuator	General Electric Co. Feb. 28, 1956	APDA	167,500	145,000
C-1	Primary Shield Tank	Chicago Bridge & Iron Co. Dec. 14, 1955	APDA	106,000	106,350
C-2	Reactor Vessel	Combustion Engineering Co. Oct. 17, 1955	APDA	915,800	915,800
C-3	Rotating Plug	Combustion Engineering Co. Oct. 17, 1955	APDA	346,350	346,350
"	Index System & Drives	General Electric Co. Feb. 17, 1956	APDA	60,000	60,000
C-4	2 Control Rods	Allis-Chalmers Mfg. Co. Dec. 2, 1955	APDA	34,608	35,000
C-5	2 Control Rod Actuators	General Electric Co. Sept. 19, 1955	APDA	51,200	51,200
C-7	Overhead Crane	Whiting Corp. Dec. 19, 1956	PRDC	200,000	193,315
C-8	Offset Element Handling Mechanism	General Electric Co. Aug. 25, 1955	APDA	190,500	190,500

(Con'd.)

(Cont'd.)

SUMMARY OF MATERIAL ON ORDER

Acker Exh. #7

No.	*Item*	*Proposal From*	*On Order By*	*Estimated Amount Without Contingencies (Acker Exh. #7)*	*Order Amount*	
D-1	1 Na Pump	Byron Jackson Oct. 7, 1955	APDA	3 Pumps for $410,000	$143,594	
"	1 16" Check Valve	Edward Valves Co. Sept. 29, 1955	APDA	3 Valves for $28,000	7,700	(Valve purchased and received)
D-5	1 Sodium Piping Loop	M. W. Kellogg Co. Oct. 28, 1955	APDA	3 Loops for $165,000	59,628	
D-6	6" Blanket Flow Valve	Copes-Vulcan Co. (Re-bid Jan. 3, 1957)	APDA	3 Valves for $30,000	14,635	

NOTE: In addition to the foregoing, construction work on reactor containment vessel foundations and external concrete work (Acker Exh. 7, – Item B-1) has been contracted for and completed to the extent therein stated, and a portion of the steel plate shielding and structural steel listed in Item B-3 has been ordered from N. C. Mahon Co. and Ingals Iron Works Co., respectively.

Fill and muck removal and provisions for rip-rap materials (Items #1 and A-2) have been completed at a total cost to PRDC of $152,580.87. Most of the yard lighting has also been completed (Item A-8) at a cost to PRDC of $6,370.47.

[4751]

Exhibit Acker 26

PLUTONIUM REVENUES BASED ON PLUTONIUM PRICE OF $12.00 PER GRAM AFTER JUNE 30, 1963 ON UNESCALATED AND ESCALATED BASES.

Year ended August 31	*Plutonium Price $12.00 per gram after June 30, 1963*	*Plutonium Price after June 30, 1963 $12.00 per gram escalated at 4.2% pursuant to basis set forth in AEC Announcement dated May 31, 1957*
1962	$ 622,000	$ 787,000
1963	1,200,000	1,578,000
1964	849,000	1,155,000
1965	1,057,000	1,515,000
1966	1,776,000	2,654,000
1967	1,468,000	2,261,000
1968	1,385,000	2,248,000
1969	1,477,000	2,495,000
1970	1,879,000	3,275,000
1971	2,426,000	4,454,000
Total:	$14,139,000	$22,422,000
Total Plutonium Revenue Based $30 per gram Unescalated price after June 30, 1963 (Exhibit XLIV)	32,750,000	32,750,000
Difference:	$18,611,000	$10,328,000

[4752]

Exhibit Acker 27

REVISED ESTIMATE OF WASTE DISPOSAL EQUIPMENT.

(Exhibit Acker #7, Item I-5).

Item	*Estimate*
2 Hold-up basins (concentric construction)	$ 80,000
6 Hold-up tanks	22,500
Piping	12,000
Waste Storage Building	16,000
Sypron Tank	15,000
Basin Liners (if required)	20,000
Bailing Equipment	5,000
Total:	$170,500
Contingency allowance 15%:	25,575
Total including contingencies:	$196,075

[4753]

Exhibit Acker 28

ACTUAL AND ANTICIPATED EXPENDITURES BY PRDC AND APDA COMBINED APPLICABLE TO PRDC REACTOR PROJECT.

A. *Estimated Plant Cost*	$31,675,000
(Per CAY estimate, new schedule, Exh. XLII, excluding allowance for working capital) [Estimate old schedule, Exh. XXVII, = $31,225,000]	

B. *Administrative and Overhead Expenses*

1. PRDC (Exh. XLIII, new schedule) ..... [Estimate, old schedule, Exh. XXVII = $1,816,000]	$2,170,000	
2. APDA Actual Expenses 1954-1956 (Exhibit Acker #4)	$1,015,879	
3. APDA Budgeted Expenses allocable to PRDC (66-2/3% of total budgeted expenses of $1,242,100, Exh. Acker #4)	$ 828,067	$ 4,013,946

C. *Engineering and Design Expenses in Addition to Those Included in CAI Cost Estimate*

1. APDA actual expenses 1954-1956 (18% of actual total "research and other test expenses" for 1954-56 of $5,429,021, Exh. Acker #4)	$ 977,224	
2. APDA budgeted expenses, 1957-58 (18% of 66-2/3% of $6,514,687 budgeted "research and other test expenses" for 1957-58*, Exh. Acker #4)	$ 781,762	$ 1,758,986

* None of 1959 "Research and other test Expenses" (Exh. Acker #4) is estimated to be allocable to additional engineering and design expenses. At least 66⅔% of the item referred to is estimated to be allocable to PRDC work

[4754]

D.	*Research and Development Expenses*		
	(Other than Engineering and Design)		
	1. APDA predecessor companies, 1952-53 (Exh. Acker #4, "undistributed expenses")	$ 619,932	
	2. APDA Actual Research Expenses, 1954-1956, of $5,429,021 (Exh. Acker #4, "research and other test expenses"), less $977,224 allocated to engineering and design expenses, item C. 1, above	$4,451,797	
	3. APDA Budgeted Research Expenses 1957-59 allocable to PRDC (66-2/3% of total "research and other test expenses" for 1957-59 of $8,939,327, less $781,762 allocated to engineering and design expenses, item C. 3 above)	$5,177,790	
	4. PRDC Research	$5,000,000	$15,249,519
E.	*Non-Nuclear Component Test Expenses*		
	1. APDA Budgeted Expenses for Major Components Test Operations 1958-59 (Exh. Acker #4)	$ 724,573	
	2. APDA Budgeted Expenditures on test equipment and devices over and above items included in plant cost		

estimates ($4,437,623 in Exh. Acker #4, less $4,131,700 in Exh. Acker #6)	$ 305,923	$ 1,030,496
F. Allowance for Working Capital		$ 1,175,000
Total		$54,902,947

[4755]

Notes

The figures included in the foregoing are taken from Application Exhibit XLII and Exhibit Acker 4. In order to be conservative the plant costs and PRDC administration expenses have been based on the proposed new construction schedule.

APDA actual and anticipated expenses set out in Exhibit Acker 4 have been allocated as follows:

(1) All of the actual APDA expenditures through the end of 1956 are allocated to the PRDC project.

(2) All of the major component test expenses, actual and anticipated, and including both operations expenses and equipment and devices are allocated to the PRDC project.

(3) Two-thirds (66-2/3%) of anticipated "research and other test expenses" and of anticipated "administrative expenses" are allocated to the PRDC project, the other one-third being assumed to be for advanced planning and general research. This is believed to be a conservatively low allocation. For convenience, the 66-2/3% has been applied equally to all three years; as a practical matter, however, a high-

er percentage of APDA work will be devoted to the PRDC project in the earlier portion of this period, and a smaller percentage in the later portion.

(4) Of the "research and other test expenses" set out in Exhibit Acker 4 and allocated to the PRDC project, 18% for the years 1954 through 1958 is estimated to be for engineering and design services by APDA. The remainder is estimated to be other research, development, and test expenses. Since most of the design work is expected to be completed before 1959, none of the anticipated APDA expenditures for that year has been allocated to engineering and design costs.

[4756]

(5) On the foregoing basis, APDA's budgeted expenditures for equipment and devices for the component test operation and for research, design and test work in 1957-1959 allocable to the PRDC reactor are in excess of $10,000,000. In its own cost projections, however, PRDC has conservatively valued the equipment and services to be received from APDA in this period at $7,000,000, of which $3,000,000 has been allocated to equipment and devices incorporated in the reactor, and $4,000,000 to services, including design, test operations and research. This is, of course, in addition to the cost of APDA research and design work done in previous years, none of which has been incorporated in the PRDC cash flow projections or cost estimates.

[4757]

Exhibit Acker 29

PRDC COMMITMENTS AND EXPENDITURES ON RESEARCH

ALREADY LISTED IN EXHIBIT ACKER NO. 11

	Commitment	*Amount Expended as of May 31, 1957*
1. *William McGuire and Gordon P. Fisher* Containment studies. Commitment has been increased from $5,000 to $10,000	$10,000	$ 6,239
2. *General Nuclear Engineering Corporation* Cask car design. Commitment has been increased from $50,000 to $60,000	$60,000	$23,020
3. *Nuclear Metals, Inc.* Meltdown experiments	$60,000	$32,228
4. *The Regents of the University of Michigan* Meteorological evaluation. Commitment has been increased from $27,000 to $45,000 and includes cost of tower and instrumentation.	$45,000	$36,417

ARRANGEMENTS POST-DATING EXHIBIT ACKER NO. 11

	Estimated Cost	*Amount Expended as of May 31, 1957*
1. *Holley Carburetor Company* Control system simulator study	$135,125	—
2. *Armour Research Foundation* Containment studies	$ 10,000	—

[4758]

	Estimated Cost	Amount Extended as of May 31, 1957
3. *General Nuclear Engineering Corporation* General consulting services (Dr. Walter H. Zinn)	$ 25,000	—
4. *University of Michigan* Site studies: meteorological diffusion (W. E. Hewson); off-site ground water (J. H. Zumberge); lake currents (J. Ayers)	$ 50,000	—
5. Consultants (physics and site)	$ 30,000	—
Totals:	$425,125	$97[illegible]

Note: Above list excludes APDA-PRDC contract which involves payments by PRDC to APDA.

[4759]

APDA COMMITMENTS AND EXPENDITURES (SINCE JANUARY 1, 1957) ON RESEARCH AND OTHER TEST WORK RELATED TO PRDC PROJECT

1. *Expenditures*

Of APDA research expenditures in the total amount of $1,154,118 listed on Schedule C of Exhibit XXXVIII for the period January 1-June 30, 1957, there was related to the PRDC project approximately $1,011,000

2. *Commitments*

As of June 30, 1957 APDA had formal or informal commitments for research and

development work of approximately $1,302,000, of which there is allocated to the PRDC project approximately 1,124,000

Total APDA expenditures and Commitments for Research, Tests, etc., Related to PRDC project $2,135,000

[4830]

Intervenors' Exhibit 5

UNITED STATES ATOMIC ENERGY COMMISSION
PLUTONIUM GUARANTEED FAIR PRICES

U. S. FEDERAL REGISTER—JUNE 6, 1957

Volume 22 Page 3985

1. The prices contained in this schedule are "guaranteed fair prices" determined in accordance with the provisions of section 56 of the Atomic Energy Act of 1954 for plutonium lawfully produced under license from the Atomic Energy Commission, and delivered to the Commission at the designated receiving point within the time specified below.

2. Guaranteed fair prices previously established by the Commission for plutonium delivered to the Commission after January 31, 1957, are superseded by the prices established in this schedule.

3. It is emphasized that, while the Commission intends to extend the guarantee period for plutonium prices each year for one additional year, the prices which will be established for subsequent years may be different from those

previously in effect. In particular, it is the expectation of the Commission that the prices for plutonium will be reduced, as dictated by consideration of the value of the material for its intended use by the United States and giving such weight to the actual cost of producing the material as the Commission finds to be equitable, to a level based upon the fuel value of plutonium in commercial power reactor facilities.

4. Chemical specification: Total plutonium content to be not less than 99.5% by weight.

5. Physical specification: The content of beta and gamma emitting isotopes other than plutonium will be measured indirectly in terms of the radiation level. The average radiation level of a shipment of buttons shall not exceed ⅓ mr/hr/gram. The radiation level of any one button, enclosed within a plastic envelope shall not exceed ½ mr/hr/gram. These measurements are to be made with an air ionization type gamma survey meter with window closed, at a distance of two inches from the button "top."

6. Form: Solid metal buttons, free of slag, reductant, and mold fragments. Buttons to weigh not less than 200 grams each nor more than 2,0[illegible] grams each.

7. Packaging: The plutonium metal is to be packaged in suitable containers and shipped in accordance with Government regulations.

AEC will either return reuseable containers to common carrier at the designated receiving point or will make proper adjustment for the value of the containers.

8. Prices paid will be as follows:

(a) For plutonium delivered to U. S. Atomic Energy Commission at designated receiving point during the period beginning February 1, 1957 and

[4831]

ending midnight June 30, 1962:

% Pu-240:	*Price $/gr of Plutonium*
0.0	45.00
2.0	41.50
4.0	38.00
6.0	34.50
8.0	31.00
8.6 and over	30.00

(b) For plutonium delivered to U. S. Atomic Energy Commission, at the designated receiving point during the period beginning July 1, 1962 and ending midnight June 30, 1963: $30 per gram of plutonium.

9. The designated receiving point is U. S. Atomic Energy Commission, Rocky Flats Plant, Rocky Flats, Colorado (a suburb of Denver, Colorado).

10. Fair prices paid by AEC for special nuclear materials which meet the specifications set forth above and are delivered to designated receiving points prior to midnight June 30, 1963, may not be reduced by the Commission except as provided in this paragraph. The prices are, however, subject to upward or downward adjustment semiannually when substantial changes have occurred in the "Wholesale Price Index, excluding Farm Products and Processed Foods," published by the Bureau of Labor

Statistics. The July 1955 index of 116.5 (1947-1949 = 100) is used as the initial base. If the October index of any year is greater or less than the base index by five percent or more, the prices may be adjusted the following January 1. Similarly, if the April index of any year is greater or less than the base index by five percent or more, the prices may be adjusted the following July 1. Prices may be adjusted by the percentage change which has occurred in the index, the adjusted prices being computed to the nearest cent. Following such an adjustment, the index used in computing the adjustment will become the new base.

11. Interested persons may contact:

U. S. Atomic Energy Commission
Division of Civilian Application
1901 Constitution Avenue
Washington 25, D. C.

Dated at Washington D. C., this 31st day of May, 1957.

FOR THE ATOMIC ENERGY COMMISSION

R. W. Cook
Deputy General Manager.

VOLUME II

TRANSCRIPT OF RECORD

Supreme Court of the United States

OCTOBER TERM, 1960

No. 315.

POWER REACTOR DEVELOPMENT COMPANY, PETITIONER,

vs.

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL-CIO, ET AL.

No. 454

UNITED STATES, ET AL., PETITIONERS,

vs.

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL-CIO, ET AL.

ON WRITS OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT.

NO. 315 PETITION FOR CERTIORARI FILED AUGUST 12, 1960

NO. 454 PETITION FOR CERTIORARI FILED SEPTEMBER 29, 1960

CERTIORARI GRANTED NOVEMBER 14, 1960

VOLUME II—JOINT APPENDIX

IN THE

United States Court of Appeals

FOR THE DISTRICT OF COLUMBIA CIRCUIT

No. 15,271

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL-CIO; UNITED AUTOMOBILE, AIRCRAFT AND AGRICULTURAL IMPLEMENT WORKERS OF AMERICA; and UNITED PAPERMAKERS AND PAPERWORKERS,

Petitioners,

v.

UNITED STATES OF AMERICA, and ATOMIC ENERGY COMMISSION,

Respondents,

POWER REACTOR DEVELOPMENT COMPANY and STATE OF MICHIGAN,

Intervenors.

ON PETITION TO REVIEW AND SET ASIDE AN ORDER OF THE ATOMIC ENERGY COMMISSION

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BATAVIA TIMES, LAW PRINTERS
BATAVIA, N. Y.

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[4852]

Commission Exhibit No. 3.

UNITED STATES ATOMIC ENERGY COMMISSION,
Washington 25, D. C.
United States
Atomic Energy Commission

THEORETICAL POSSIBILITIES AND CONSEQUENCES OF MAJOR ACCIDENTS IN LARGE NUCLEAR POWER PLANTS, MARCH 1957

[4853]

UNITED STATES
ATOMIC ENERGY COMMISSION
Washington 25, D. C.

(Seal)

March 22, 1957

Dear Mr. Durham:

There is transmitted herewith a report of a study of the possible consequences in terms of injury to persons and damage to property, if certain hypothetical major accidents should occur in a typical large nuclear power reactor.

More than two score leading experts in the sciences and engineering specialties participated in this study.

We are happy to report that the experts all agree that the chances that major accidents might occur are exceedingly small.

This study constitutes a part of the Commission's continuing effort on a broad front to understand and resolve this

problem of possible reactor hazards so that we may proceed with an expanding atomic energy industry with full confidence that there will be few reactor accidents and that such as do occur will have only minor consequences. This effort and the work of translating the results into affirmative, concrete safeguards for protection of the public will, of course, be continued and expanded.

Since the beginning of the reactor program the experts and the Congress and the public and the Commission have all been concerned with the causes of and the possible magnitude of damage from reactor accidents and with means of prevention. The subject was considered important enough to command four of the 60-odd sessions of the International Conference on the Peaceful Uses of Atomic Energy in Geneva eighteen months ago, which, as you will recall, we initiated. One conference paper in particular gave estimates of the theorefical magnitude of damage. In May of last year, Dr. Libby presented to your Committee some estimation of the possible extent of harm and damage should a major accident occur.

This study has taken the form in which it is now presented to you as a means of responding to the Committee's specific request of last July 6. To produce such a study, it was necessary to stretch possibility far out toward its extreme limits. Some of the worst possible combinations of circumstances that might conceivably occur were included

[4854]

in the hypotheses in order that we might assess their consequences. The study must be regarded only as a rough estimation of the consequences of unlikely though con-

ceivable combinations of failure and error and weather conditions; it is not in any sense a prediction of any future condition.

This has been a difficult study to make. There has fortunately been little reactor accident experience upon which to base estimates. Nuclear reactors have been operated since December 2, 1942, with a safety record far better than that of even the safest industry. More than 100 reactor years of regular operating experience have been accumulated, including experience with reactors of high power and large inventories of fission products, without a single personal injury and no significant deposition of radioactivity outside of the plant area. There have been a few accidents with *experimental* reactor installations as contrasted with the perfect record of safety of the regularly operating reactors. But even these accidents did not affect the public.

This record which shows that safe operation can be achieved is due to skillful design, careful construction, and competent operation.

Looking to the future, the principle on which we have based our criteria for licensing nuclear power reactors is that we will require multiple lines of defense against accidents which might release fission products from the facility. Only by means of highly unlikely combinations of mechanical and human failures could such releases occur. Furthermore, the Government and industry are investing heavily in studies to learn more about the principles of safe reactor design and operation.

Framing even hypothetical circumstances under which harm and damage could occur and arriving at estimations

of the theoretical extent of the consequences proved a complex task.

To make the study we enlisted the services of a group of scientists and engineers of the Brookhaven National Laboratory and of another group of experts to serve as a steering committee. Through recent months these men have met with many additional expert advisors to test our judgments on the estimates arrived at.

We are not aware of such a study having been undertaken for any other industry. We venture to say that if a similar study were to be made for certain other industries, with the same free rein to the imagination,

[4855]

we might be startled to learn what the consequences of conceivable major catastrophic accidents in those other industries could be in contrast with the actual experience in those industries.

Remembering that this study analyses theoretical possibilities and consequences of reactor accidents, we might note here the judgments presented on (1) possible consequences of major accidents and (2) the likelihood of occurrence of such major reactor accidents.

The portion of the study dealing with consequences of theoretical accidents started with the assumption of a typical power reactor, of 500,000 kilowatts thermal power, in a characteristic power reactor location. Accidents were postulated to occur after 180 days of operation, when essentially full fission product inventories had been built up.

Three types of accidents which could cause serious public damages were assumed. Pessimistic (higher hazard) values were chosen for numerical estimates of many of the uncertain factors influencing the final magnitude of the estimated damages. It is believed that these theoretical estimates are greater than the damage which would actually occur even in the unlikely event of such accidents.

For the three types of assumed accidents, the theoretical estimates indicated that personal damage might range from a lower limit of none injured or killed to an upper limit, in the worst case, of about 3400 killed and about 43,000 injured.

Theoretical property damages ranged from a lower limit of about one half million dollars to an upper limit in the worst case of about seven billion dollars. This latter figure is largely due to assumed contamination of land with fission products.

Under adverse combinations of the conditions considered, it was estimated that people could be killed at distances up to fifteen miles, and injured at distances of about forty-five miles. Land contamination could extend for greater distances.

In the large majority of theoretical reactor accidents considered, the total assumed losses would not exceed a few hundred million dollars.

[4856]

As to the probabilities of major reactor accidents, some experts held that numerical estimates of a quantity so vague

and uncertain as the likelihood of occurrence of major reactor accidents have no meaning. They declined to express their feeling about this probability in numbers. Others, though admitting similar uncertainty, nevertheless ventured to express their opinions in numerical terms. Estimations so expressed of the probability of reactor accidents having major effects on the public ranged from a chance of one in 100,000 to one in a billion per year for each large reactor. However, whether numerically expressed or not, there was no disagreement in the opinion that the probability of major reactor accidents is exceedingly low.

Some of the reasons for this belief follow:

First, industry and government are determined to maintain safety and protect the health and property of the public from nuclear hazards. The Congress has authorized and we in the Commission are carrying out a program of close and careful regulation and inspection. Thus the potential hazard of this new industry has been recognized in advance of its development and brought under a strict system of safety control before the occurrence of the incidents which in other fields have marked the birth of new industry and have subsequently led to control.

Secondly, the challenge of this new and important venture in man's application of the forces of nature has attracted able and energetic men into the work of assuring safe design and operation.

In the third place, multimillion dollar efforts in research and development, both public and private, are directed toward identifying and solving safety problems. We know of no other industry where so much effort has been and is

being spent on the definition and solution of safety problems.

Fourthly; the cost to the industry and government of reactor accidents, even of a minor nature, would be very high—much higher than for accidents in other industry. Self-interest, therefore, as well as public interest dictates avoidance of accidents.

To sum up, the report affirms that a major reactor accident is extremely unlikely. To reduce the matter of assumed hazards to comparative numbers, let us take the most pessimistic assumptions used and apply them to a case of 100 power reactors in operation in the United States.

[4857]

Under these assumptions, the chances of a person being killed in any year by a reactor accident would be less than one in 50 million. By contrast the present odds of being killed in any year by an automobile accident in the United States stand at about one in 5,000.

We are not surprised by the contents of the report nor are we made complacent. The report serves to identify areas where continued research and development are needed, and areas where emphasis is needed in the further development of our regulatory program. It gives renewed emphasis to our belief that our research and development program and our regulatory program in the nuclear power field must continue with vigor to the end that the "conceivable" catastrophe shall never happen.

We would appreciate your regarding the attachment as an "advance" report. It is being reviewed for editorial

and mechanical errors and omissions. Copies of the report as corrected will be furnished to you at an early date.

Sincerely yours,

/S HAROLD S. VANCE
Acting Chairman

Enclosure:
"Theoretical Possibilities
and Consequences of Major Accidents
in Large Nuclear Power Plants"

Honorable Carl T. Durham
Chairman, Joint Committee on
Atomic Energy
Congress of the United States

[4885]

Degrees of Land Contamination

By far the largest dollar cost to the public of a major reactor accident would result from contamination of land areas by deposited fission products. Inhabitants of portions of the areas affected would have to be evacuated to avoid serious exposure. Access to various areas might be denied for different lengths of time, and the subsequent use of land for agricultural purposes might be curtailed, with possible loss of standing crops. The same basic exposure-injury criteria listed above (column 1) were used also for determining the consequences of land contamination. Details of calculations are shown in Appendix D. In the case of land contamination, the existence of specific isotopes especially strontium^{90}, must be considered

very carefully. The severe restrictions that might be imposed on farming arise almost entirely from the existence of this particular isotope.

To estimate the potential loss arising from problems of land contamination both the number of persons and the area affected were calculated. In some instances the costs were evaluated by associating them with an average cost per person. In the particular cases associated with farm restriction an average cost per square mile was used

[4886]

The categories chosen, and costs assumed for each are:

Range I.	Evacuation of personnel—immediate	$5000/person
Range II.	Evacuation of personnel—orderly and in a reasonable time	$5000/person
Range III.	Restrictions on land and outdoor activity	$ 750/person
Range IV.	Crop and farm restriction	$25,000/sq. mile

The criteria used in establishing these ranges are described in Appendix D. It should again be emphasized that they are based on meager data.

Reactor Accidents Assumed

Three types of reactor accidents were considered necessary for this study in order to indicate the range of public hazard which could result and to delineate the influence of the important variables as described above on the mag-

nitude of these hazards. The three "typical" cases selected are:

A. *The Contained Case*

In this accident, it is assumed that all of the fission products from the 500,000 Kw (thermal) reactor, after 180 days of operation, are released from the core and distributed uniformly throughout the interior of the containment building. None is assumed to escape. The fission products are assumed to decay at their natural rate, with no attempt at decontamination, etc., after the accident. Hazard to the public

[4887]

would arise from the direct gamma radiation from the fission products dispersed inside the containment building. One inch of steel shielding by the walls of the building is assumed. The site boundaries are 2000 feet from the reactor.

B. *The Volatile Release Case*

In this case it is assumed that all of the volatile fission products in the reactor (500,000 Kw (thermal) after 180 days), *i.e.*, xenon, krypton, iodine, bromine and 1% of the strontium are released from the containment building and are subsequently dispersed, with characteristics and meteorological conditions as described and specified above. See Appendix A.

C. *The 50% Release Case*

In this case, it is assumed that 50% of all fission products in the reactor (500,000Kw (thermal) after 180 days) are released from the containment building and are subsequently dispersed, with characteristics and meteorological conditions as described and specified above. See Appendix A.

Each of these arbitrary cases represents a highly pessimistic assumption. Certainly more catastrophic releases of the Contained and the Volative types are not possible. In the third type, it is conceivable that more than 50% of all fission products could be released, but this is considered to be so far in the realm of incredibility as not to merit consideration.

[4889]

ESTIMATED CONSEQUENCES OF THE ASSUMED REACTOR ACCIDENTS

In this part of the report, there is presented a brief summary of the calculated damages obtained from each of the assumed accidents, together with brief observations and pertinent comments on the results obtained in the respective cases. Reference is made to Appendices H and I, of Part IV, for more complete tabulation of results.

Case I—The Contained Case

The assumption is made at all of the fission products are vaporized and dispersed within the contain-

ment shell. There is no release to the atmosphere. Damage to the public would then result from direct exposure to gamma radiation. The following tabular summary shows personal injuries and evacuation costs beyond the 2000 feet boundary of the reactor site.

	Personal Injury	
	Assuming evacuation in 2 hours (persons)	*Assuming evacuation in 24 hours (persons)*
Lethal exposure	0	0
Injury likely	0	6
Injury unlikely, but expense likely	1	15

Evacuation Costs		
Number of People	*Area*	*Cost*
67	1.8 sq. mi.	$335,000

[4890]

Observations and Remarks

1. The above results would be the maximum possible for this type of accident in that all fission products would be involved and no shielding except the container is assumed.

2. Under the best conditions, namely, prompt evacuation of nearby personnel, no personal injury would be likely. The public loss would be due entirely to evacuation costs and payments for denial of use of land. This can be measured in the hundreds of thousands of dollars.

3. Under less favorable conditions, namely, slower evacuation, a small number of personal injuries might be expected.

4. Use of the typical site and population distribution is less satisfactory for this case since nearby population variations from site to site are larger than the numbers of people affected. The method does, however, give an order-of-magnitude.

5. For smaller site boundaries, larger numbers of people would be affected, especially in the injury category. However, with proper combinations of distance and shielding no loss to the public would be involved.

CASE II—THE VOLATILE RELEASE

Here it was assumed that, because of a breach in the container or failure to close all openings, all volatile fission products would be discharged to the atmosphere at the time of the accident. Four different situations of meteorological conditions and two particle size distributions were considered. Furthermore, separate indication is given for releases which include 1 percent of the strontium inventory and for those which do not.

A full summary of the calculated damages is contained in Appendix I. The following table contains a brief summary to indicate the magnitude and range of the consequences.

[4891]

The Volatile Release Case

Personal Injury

A. *Lethal exposure*	*Persons*	*Conditions at Release*
Minimum	2	Tempertaure lapse
Maximum	900	Temperature inversion, 1μ particles

Assuming that (1) the particle size distributions are equally probable, and (2) the distribution of weather conditions is as stated in Appendix I, then lethal exposures would be less than five people for those accidents which might occur during about one-half of the time or less than 300 people for those accidents which might occur during about three-fourths of the time.

B. *Injury Likely*	*Persons*	*Conditions at Release*
Minimum	10	Temperature lapse 7μ particles
Maximum	13,000	Temperature inversion 1μ particles

Using the same assumptions as under A, the number of persons injured would be less than 20 people for those accidents which might occur during about one-half of the time or 2000 people for those accidents which might occur during about three-fourths of the time.

Property Damage

II. *Evacuation*	*Persons*	*Area (sq. mi.)*	*$ Millions*	*Conditions*
Minimum	0	—	—	Temperature lapse, dry
Maximum	41,000	28	205	Temperature inversion, rain

[4892]

Under the same assumptions as under A, the number of persons requiring evacuation would be less than 1000 people for accidents which might occur during about two-thirds of the time or 6000 people for those accidents which might occur during about nine-tenths of the time.

III. General Restrictions (due to Sr)	Persons	Area (sq. mi.)	$ Millions	Conditions
Minimum	20	1	.01	Temperature lapse, dry, 1μ
Maximum	235,000	350	177	Temperature lapse, rain, 1μ

Under the same assumptions as under A, the area placed under general restrictions would be less than 50 sq. mi. for those accidents which might occur during about three-fourths of the time.

IV. Agricultural Restrictions (due to Sr)	Area (sq. mi.)	$ Millions	Conditions
Minimum	3	.1	Temperature lapse, dry, 1μ
Maximum	3,500	90.	Temperature lapse, rain, 1μ

Under the same assumptions as under A, the area placed under agricultural restrictions would be less than 500 sq. mi. for those accidents which might occur during about nine-tenths of the time.

Observations and Remarks

1. The number of personal injuries is highly dependent upon existing weather conditions at the time of the accident. Few lethal exposures would occur during daytime conditions. Exposures of large numbers of persons would occur during temperature inversions, typical of nighttime conditions.

[5116]

Original Application for License by PRDC

POWER REACTOR DEVELOPMENT COMPANY
A NON-PROFIT CORPORATION
1100 DIME BUILDING
DETROIT 26, MICHIGAN

January 6, 1956

United States Atomic Energy Commission
Division of Licensing
Washington 25, D. C.

Attention: Harold Price, Director

Gentlemen:

We are submitting herewith our application for a class 104 license to build, own, and operate a developmental fast neutron breeder reactor which will produce the heat energy required to generate 100,000 kw electric power.

The construction of this reactor was proposed on behalf of a group of companies interested in reactor development as a part of the Commission's Power Demonstration Reactor Program in a letter dated March 30, 1955 and signed by myself as President of The Detroit Edison Company. It was stated in the proposal that in the event of the Commission's acceptance, a new company would be organized to carry out the project.

Since August 8, 1955 when the Commission approved the proposal as a basis for further negotiations, our Company has been incorporated under the laws of Michigan and steps are rapidly being taken to put it on an operating basis.

This application is being submitted now so that we may undertake the detailed design of the reactor and begin field construction within the next few months. Early construction is necessary if we are to meet the proposed schedule. We would appreciate, therefore, the issuance of a construction permit at the earliest possible date.

We will, of course, be pleased to meet with you at any time to discuss any matters concerning this project, and to supply and additional information you may need for consideration of this application.

Yours very truly,

WALKER L. CISLER
WALKER L. CISLER
President

[5117]

POWER REACTOR DEVELOPMENT COMPANY · January 6, 1956

APPLICATION FOR LICENSE UNDER ATOMIC ENERGY ACT OF 1954

Submitted by
POWER REACTOR DEVELOPMENT COMPANY
1100 Dime Building
Detroit 26, Michigan

This application for the necessary license to design, construct, and operate a developmental fast neutron breeder reactor, to be located in Frenchtown Township, Monroe County, Michigan about 40 miles southwest of Detroit is submitted by Power Reactor Development Company (here-

inafter referred to as Applicant) pursuant to the Atomic Energy Act of 1954 and regulations thereunder.

The proposed reactor, to have an initial capacity of producing 100,000 kw electricity is to be built as a part of the Commission's "Power Demonstration Reactor Program" in accordance with the proposal submitted March 30, 1955 in a letter signed by Walker L. Cisler, President of The Detroit Edison Company (see Exhibit I).

The proposal was approved by the Commission as a basis of further negotiation on August 8, 1955 (see Exhibit II).

It is important to note that the atomic power plant with which this application is concerned will be built as two separate parts, (1) the breeder reactor and related facilities, including the fuel handling system, coolant systems, and steam generators (boilers) which will be designed, built, owned and operated by the applicant and (2) the conventional steam turbine generator and related facilities, including the transmission line which will be designed, built, owned and operated by The Detroit Edison Company (hereinafter referred to as Edison). Applicant will enter into a contract with Edison providing for the sale of steam produced by the reactor to Edison. Edison will utilize the steam so purchased in its turbine generator and will utilize the electric power produced in its own power system.

This application therefore relates only to the breeder reactor part of the plant but certain information concerning the facilities to be owned by Edison are included to show the completeness of the planning.

[5118]

Applicant

Power Reactor Development Company
1100 Dime Building
Detroit 26, Michigan

Applicant is a non-profit membership corporation organized in Michigan on August 30, 1955 (see Exhibit III for Articles of Incorporation, Exhibit IV for By-Laws).

The principal officers are:

Walker L. Cisler, President
The Detroit Edison Company
2000 Second Avenue
Detroit 26, Michigan

R. George Rincliffe,
Executive Vice President
Philadelphia Electric Company
1000 Chestnut Street
Philadelphia 7, Pennsylvania

Dan E. Karn, Vice President
Consumers Power Company
212 W. Michigan Avenue
Jackson, Michigan

Herbert S. Scholz, Vice President
Southern Services, Inc.
600 N. 18th Street
Birmingham 2, Alabama

Errol W. Doebler, Vice President
Long Island Lighting Company
250 Old Country Road
Mineola, Long Island, New York

John A. Lagrou, Treasurer
17387 Monica Avenue
Detroit 21, Michigan

Leo I. Franklin, Secretary
1100 Dime Building
Detroit 26, Michigan

All of the above officers are United States citizens.

See Exhibit V for Board of Trustees. See Exhibit VI for Members of Power Reactor Development Company.

No alien, foreign corporation or foreign government has any control whatsoever over the applicant.

[5119]

License

Applicant requests a Class 104 license for a period of 25 years.

Technical Qualifications

Most of the member companies of Power Reactor Development Company have been engaged in atomic studies and development work from 2 to 10 or more years and qualified personnel from those companies will be available to assist in the management of the applicant's activities. In addition applicant will engage qualified organizations such as Atomic Power Development Associates, Inc. (hereinafter referred to APDA), Nuclear Development Corporation of America and others to assist in the development, design, construction and operation of the proposed facility.

Purpose of the Facility

This developmental breeder reactor which will have the capacity to produce the heat required to generate 100,000 kw of electricity is to be constructed as a part of the Commission's "Power Demonstration Reactor Program" to obtain technical and economic information with respect to large power breeder reactors, and to gain experience and knowledge in the design, construction and operation of such reactors.

The reactor will be located on a site leased from The Detroit Edison Company, the term of the lease to be 25 years, concurrent with the term of the requested license. The facilities to be owned by Edison will be adjacent to the breeder reactor.

Financial Qualifications

Present estimates fix the cost of the proposed breeder reactor and related facilities to be owned by applicant as $40,511,000. This includes liberal allowances for all construction costs, for preoperation testing, and working capital to permit the applicant to engage in the business activities incident to the operation of the reactor.

This estimate does not include:

1. Research and development work completed by APDA which has cost nearly $10,000,000 prior to January 1, 1956.

2. Certain additional research and development work to be done by APDA which is included in the APDA budget for 1956 and 1957.

[5120]

3. The cost of certain research and development work and other assistance to be provided by the Commission under terms of the Power Demonstration Reactor Program.

4. The value of the inventory of special nuclear materials required for the operation of the reactor (see Exhibit VII for statement of materials required).

The reactor will be financed as follows:

Payments by member companies	$25,511,000
Loans from banks—guaranteed by member companies	15,000,000
Total	$40,511,000

The proposed member companies have informally agreed to make payments to applicant in excess of the above mentioned $25,511,000. Steps are now being taken to formalize these agreements.

Banks have informally agreed to loan the applicant $15,000,000 for a period of 10 years, subject to guarantees by the member companies. The bank loan agreement is now being negotiated.

It should be noted that the 26 companies that propose to become members of applicant are all substantial business organizations with large resources. It can be assumed that they easily have the capacity to see that a project of the importance of this one is carried out.

Completion Date

Zero and low power reactor operation is now scheduled to start during the summer of 1959. Full power operation is planned approximately one year later.

Since these dates depend upon much research and development work, it is possible that the above dates may be delayed up to one year.

Jurisdiction of Public Service Regulatory Agencies

Applicant will not be engaged in the generation of electric power, and will not sell energy to the public. It is anticipated therefore that applicant will not be subject to the jurisdiction of any public service regulatory agency.

[5121]

Contract between Commission and Applicant

Negotiation of a contract between the Commission and applicant which will define the services to be provided by the Commission under the Power Demonstration Reactor Program are in progress; John J. Flaherty, Manager of the Chicago Operations office acting for the Commission. The most recent draft of the proposed contract and its Appendix A is included with this application as Exhibit VIII.

TECHNICAL INFORMATION

The conceptual design and development of this proposed reactor is the work of APDA. This design is described in considerable detail in APDA Report No. 108, "Description of Developmental Fast Breeder Power Reactor Plant", which is incuded with this application as Exhibit X.

Nuclear Process to be performed

The fast breeder reactor depends upon a self-propagating chain reaction of nuclear fissions caused by neutrons re-

leased during the fission process. In this type reactor, the fission process is maintained by high energy (fast) neutrons, and more nuclear fuel is produced than is consumed. The neutrons remain at high energy, as there is no moderator. Essentially, the reactor is composed of fuel and coolant.

Liquid sodium is to be used as the primary coolant and consequently an inert gas seal system and an impurity cold trap arrangement will be provided. A description of the inert gas system and the venting system is given in the Liquid Metal and Steam Section of APDA-108 (pages 68-87).

This reactor is designed to operate on uranium-235 fuel and will produce about 300,000 kilowatts of heat with a corresponding gross electrical output of 100,000 kilowatts. Approximately 450 kilograms of uranium-235 are required for the core. The uranium-235 consumption per year is 91.7 kilograms and with a 1.2 breeding ratio, 109 kilograms plutonium will be produced per year. According to present plans reprocessing of the irradiated fuel subassemblies and the blanket subassemblies will be done by the Commission off the site, and consequently the waste disposal considerations involved in such an operation are not pertinent to this application.

Description of Facility

As detailed description of the fast breeder power plant is given in APDA-108 (see Exhibit X). Specific characteristics essential to the safe operation of the facility include:

1. A reactor designed to be stable and safe under all conceivable operating conditions.

2. An airtight, steel, cylindrical reactor building which encloses the reactor, the fuel handling mechanisms, and the primary coolant system. This building is designed to contain the products of any conceivable reactor incident that results in relase of fission products and radioactive sodium.

3. An intermediate or secondary non-radioactive coolant system which transfers heat from the primary coolant system to the water and steam system. This intermediate system is provided to avoid the release of radioactivity in the event of a NaK-water reaction.

4. An integral low-pressure primary liquid metal coolant system with equipment arranged in sumps so that removal may be accomplished without draining the system.

Safety

It has been apparent to the reactor designers since the beginning that the safety of the reactor is of paramount importance and that when there is a choice of several design alternatives, that alternative which provides the greatest inherent safety must always be accepted.

There are three general requirements of reactor safety. The first and most important is that the public be protected from any release of radioactive material which would have any adverse effects. The second is that the operators must be protected from all harmful conditions. The third is that the investment in the reactor power plant must be protected against loss due to irreparable damage to the reactor.

The design of the reactor and its auxiliary equipment has been directed so that the possibility of the reactor becoming prompt critical due to operating error is prevented. In addition, all design features have been examined carefully in order to detect any autocatylitic effects which could cause damage to the reactor. It is believed that there are no features in the present design which represent inherently dangerous mechanisms.

Adequate neutron and gamma ray shielding is provided around the reactor and primary coolant system so that radiation levels are well below tolerance to personnel. Equipment is placed in shielded compartments where this requirement is necessary.

[5123]

Although it is felt that careful design of the reactor and its equipment have made the possibility of accident extremely unlikely, it has been deemed prudent to incorporate two protective barriers between the reactor and the public. The first barrier will be a gas-tight steel building which would contain the radioactive materials released in the improbable event of a more serious accident to the reactor than any now foreseeable. The second barrier is the exclusion area afforded by the site.

During 1955, the APDA representatives met twice with a subcommitteee of the Advisory Committee on Reactor Safeguards and made one informal presentation to the entire committee. The APDA Report 108 (see Exhibit X), was prepared for the information of this committee. Suggestions and comments gathered at these conferences have been evaluated and, in many cases, worked into the design.

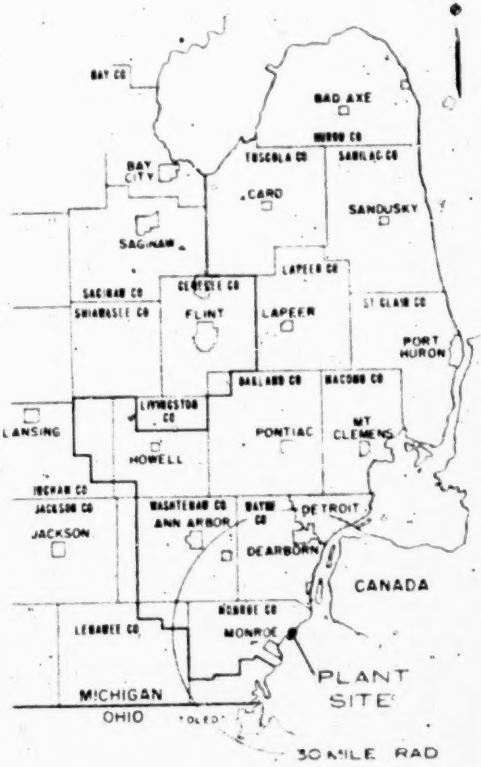
It is the policy and intent of the applicant to design, build, and operate the reactor power plant in a manner consistent with the financial and moral obligations incumbent upon the builders and operators of a facility of this nature.

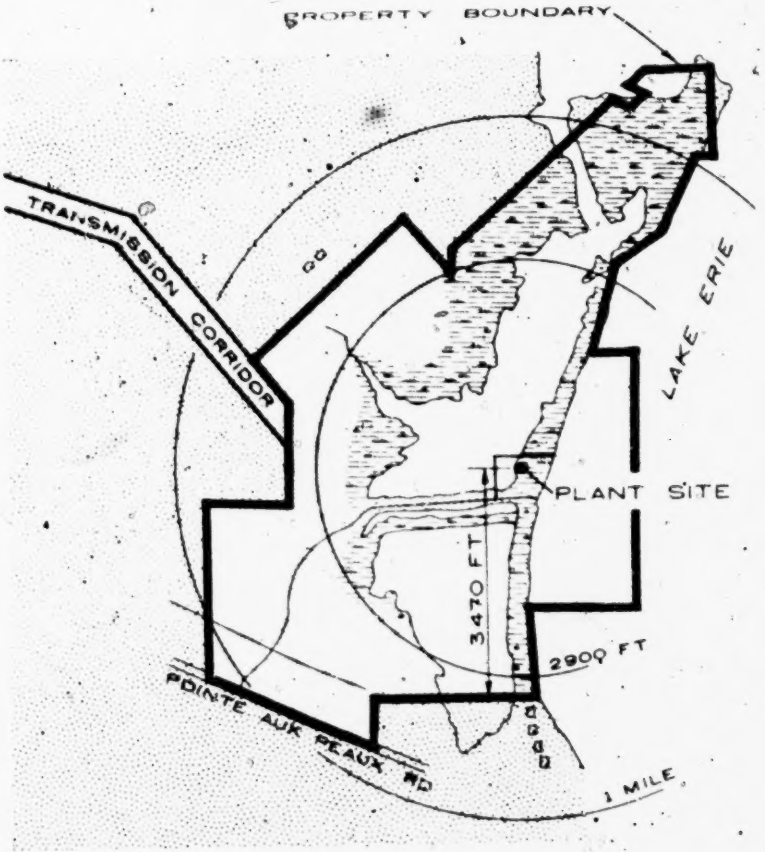
Site

The reactor and associated electric generating plant will be built on approximately 900 acres of land owned by Edison, and located about 30 miles southwest of the City of Detroit. This site is on the western shore of Lake Erie at Lagoona Beach, Frenchtown Township, Monroe County, Michigan. The property is generally low and marshy and lies in a farming territory about 7½ miles north of the City of Monroe, whose population is approximately 20,000. There are about 32,000 inhabitants within a 10 mile radius of the reactor, but less than 2,000 year-round inhabitants within a 5 mile radius. Four summer-resort communities lie within this 5 mile zone and an increase in population is experienced during the summer months. At present no industrial plants are located within this 5 mile zone.

The general location of the property with respect to the Edison service area, and an outline of the property showing the proposed location of the plant is shown by Figure 1 on the following page. Figure 2 shows a layout of the facilities on the site.

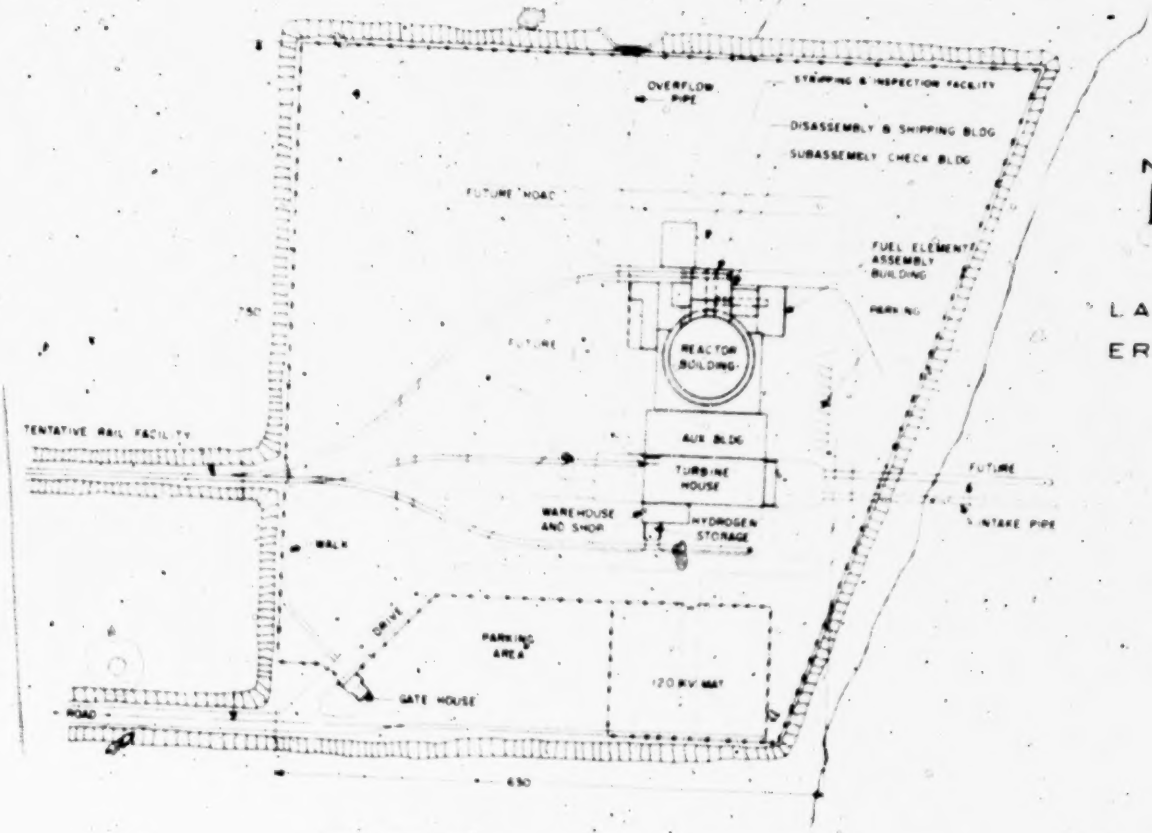
The area owned by Edison as shown by Figure 1 provides a minimum exclusion radius of 2,900 feet and there are no residences or inhabitants within 3,500 feet of the reactor site.





LOCATION OF LAGOONA BEACH PROPERTY

Fig 1



PROPOSED PLANT LAYOUT

[5125]

5125'

[5126]

The following maps provide additional detail on the site:

Exhibit *IX A*—Map of the area showing the location of the property with respect to towns and cities in lower Michigan.

Exhibit *IX B*—Aerial view of the site showing the populated areas to the south, including Monroe.

Exhibit *IX C*—A topographical map of the site showing the populated areas to the south.

The site described in APDA-108 (pages 92 and 93) is the Lagoona Beach site. Preliminary data on air pollution, climatology, geology and physiography, and sesimology for this area are present in APDA-108 (pages 92-104).

Information to be submitted Later

Some of the information requested in sections 50.34 (d), (e), (f), and (g) of 10 C.F.R. 50, is included in APDA-108 (see Exhibit X). Additional time is required before complete technical information can be supplied.

The information for (f) should be available within a year. The remaining information must await completion of the detailed design.

Summary of Applicants Requests

The applicant respectfully requests the following:

1. That the Commission grant applicant a single Class 104 license for a period of 25 years authorizing the following activities:

(a) The design, construction, ownership and operation of the reactor heretofore described, as both a production and utilization facility; and

(b) The possession and use of special nuclear material in the amounts required to construct and operate the proposed reactor,

2. That the Commission issue to applicant a construction permit for the reactor heretofore described.

3. That the Commission agree to make available to applicant special nuclear material in the amounts required to operate the reactor for the period of the license, as set forth in Exhibit VII.

[5127]

4. That the Commission agree for the period of the license to furnish the transportation (1) for the special nuclear material to the location where such material will be fabricated for use in the reactor and (2) for the irradiated fuel and blanket elements from the reactor site to the Commission facilities for recovery and decontamination of the special nuclear material contained in such elements.

IN WITNESS WHEREOF, POWER REACTOR DEVELOPMENT COMPANY has caused its name to be hereunto signed by Walker L. Cisler, its President, and its corporate seal to be hereto affixed by Leo J. Franklin, its Secretary, thereunto duly authorized, this 6th day of January 1956.

POWER REACTOR DEVELOPMENT COMPANY

By WALKER L. CISLER
President

Attest:
LEO J. FRANKL
Secretary.

• • •

[5129]

Exhibit I

THE DETROIT EDISON COMPANY
2000 SECOND AVENUE
Detroit 26, Michigan

March 30, 1955

WALKER L. CISLER
President

United States Atomic Energy Commission
1901 Constitution Avenue
Washington 25, D. C.

Gentlemen:

In furtherance of our letter of July 12, 1954, this proposal to design, construct, own and operate a fast neutron breeder reactor is submitted for your consideration in response to your January 10, 1955 announcement of a "Power Demonstration Reactor Program." It is submitted on behalf of the Central Hudson Gas and Electric Corporation, The Cincinnati Gas & Electric Company, Consumers Power Company, Delaware Power & Light Company, The Detroit Edison Company, Long Island Lighting Company, Philadelphia Electric Company, Rochester Gas and Electric

Corporation, The Toledo Edison Company, and others wh have or may hereafter signify their intention to join thi project. All but one of those named have been engaged i an intense effort to develop a breeder reactor that can b capable of producing steam for generation of electric e ergy on a commercially competitive basis.

The proposed reactor is described in some detail in th classified (Confidential) document entitled "Description o Proposed Developmental Fast Neutron Breeder Reactor," dated March 25, 1955, which is submitted as an append hereto. A photograph of a model of the reactor-electr plant is attached to this letter. The design adopted chiefly the result of the work of engineers and scientis assembled for the Atomic Power Development Associate study and research project. They reviewed informatio available from various sources, including your Commis sion Laboratories and personnel, and especially Argonn National Laboratory. They also sought out new informa tion, and developed many new ideas which have been in corporated in the design. The results also reflect the view of private contractors and investigators, consultants, an others engaged in engineering and scientific activities.

The reactor will be liquid sodium cooled, will utilize

[5130]

enriched uranium as fuel, and will be designed to produce heat sufficient for the generation of 100,000 kilowatts of electric power. Fuel elements will be made up of assemblies of clad uranium alloy pins. Blanket elements will be as semblies of depleted uranium rods.

We are prepared to meet with you at such time as you may wish, looking toward reaching a mutually agreeable understanding with respect to the following:

(a) A license to locate, construct, own and operate a reactor, to demonstrate its practical value, and

(b) A license to possess special nuclear material, and

(c) A sufficient supply of fuel and blanket materials, and

(d) The processing or irradiated fuel and blanket elements, and

(e) The payment by the Commission for special nuclear material produced by the proposed reactor, and

(f) The performance of certain research and development work in Commission facilities, and

(g) The matter of technical and economic data resulting from the reactor development.

If the foregoing and certain other problems can be satisfactorily resolved, we shall undertake to organize a nonprofit corporation (a) to design, finance and construct a fast neutron breeder reactor; (b) to own and operate the reactor; and (c) to apply for and hold licenses from the Commission for such construction, ownership and operation and the possession and use of special nuclear and source materials. This corporation would be dedicated to research and development in the use of nuclear fuels, and results would be made available to you and to others as directed by you.

[5131]

It is our judgment that the successful completion of this fast breeder reactor plant is now a matter of straight-

forward engineering development, design and construction and that detail design of the reactor is possible within the limits of the proposed construction schedule. Furthermore, the continuing study of the design may result in certain advantageous improvements.

The control and safety aspects of the reactor have been analyzed at length. These analyses demonstrate clearly, in our opinion, that the reactor will be controllable and safe beyond any credible doubt. Moreover, it will be housed in a gas-tight cylindrical steel structure designed to contain the products of a possible reactor accident.

Our present plans call for the location of the reactor in the service area of The Detroit Edison Company on a 1,200 acre site approximately 3½ miles southeast of the business district of Monroe, Michigan (see Map, Fig. 1 page 9 of appendix). Practically all of the ground area within a radius of one mile would be included in the plant site area owned by the Company. There are few residences within a two mile radius. We are also considering other sites within the service area of The Detroit Edison Company.

We believe that the reactor can be constructed and capable of producing steam for generation of electric power within approximately 4½ years after your acceptance of this proposal. This time would include a period of more than one year of preliminary operation during which significant amounts of steam might be produced.

In order to meet the time schedule desired, research and development work of the following nature, which can best be done in your Commission facilities, as offered in the

Commission announcement of January 10, 1955, would be needed:

1. Critical experiment.
2. Safety test.
3. Radiation damage tests.
4. Fuel reprocessing development.

The extent to which your Commission may desire to participate in other research is a subject we will be pleased to discuss. We would expect to work closely with Argonne which has been most helpful.

We estimate that the total cost of the reactor, exclusive

[5132]

of electric generating facilities, would range up to $45,000,000, distributed approximately as follows:

Plant Site and Improvements	$ 1,700,000
Research and Development Work	9,000,000
Engineering, Design and Construction of Reactor Plant	29,100,000
Preliminary Operation, Working Capital, Business and Miscellaneous Expense Prior to Firm Operation	5,200,000
Total Cost of Reactor	$45,000,000

Coincident with the construction of the reactor, The Detroit Edison Company, at its own cost, estimated as $9,000,000, will proceed with the construction of electric generating facilities having a capacity of not less than 100,000 kilowatts. Thus, the total cost of the entire project would be approximately $54,000,000.

We now have reasonable assurance that more than two thirds of the total estimated cost of the entire project will be available when the proposed licensee is organized and its finance plans made final. We believe it will be possible to have the balance provided by agreements of others, some of which have signified their intention to participate in this project. Of necessity the complete financing is therefore, dependent upon the joinder of others.

It would be important to us that the licensee corporation be reasonably sure of its ability to obtain adequate insurance. We understand that the Commission has joined with representatives of the insurance industry in a study of this important matter.

In making this proposal we assume and regard as essential the following: (1) that neither the licensee corporation, nor any member thereof or contributor thereto will become subject to the Public Utility Holding Company Act by reason of participation in this project, and (2) that the contributions of the members to the licensee corporation will qualify as deductible for Federal Income Tax purposes.

We would, of course, expect that the construction, ownership and operation of the reactor will be subject to complete

[5133]

regulation by the Atomic Energy Commission.

We will be most pleased to discuss this proposal with you at any time that may suit your convenience. Our de-

sire is to go forward with this project as rapidly as possible when we have reached agreement with you.

Very truly yours,

THE DETROIT EDISON COMPANY

By WALKER L. CISLER
President

Encls.

[5137]

Exhibit III

(Non-Profit)

ARTICLES OF INCORPORATION
of
POWER REACTOR DEVELOPMENT COMPANY
A Non-Profit Organization
Organized Under the Laws of the State of Michigan

These Articles of Incorporation are signed and acknowledged by the incorporators for the purpose of forming a non-profit corporation under the provisions of Act. No. 327 of the Public Acts of 1931, as amended, as follows:

ARTICLE I.

The name of the corporation is POWER REACTOR DEVELOPMENT COMPANY.

ARTICLE II.

The purpose or purposes for which the corporation is formed are as follows:

To be a business league of members of industries in the United States interested in the conservation of natural resources and the economical production of electric energy and to study, develop, design, fabricate, construct and operate one or more experimental nuclear power reactors and any or all component parts, to the end that there

[5138]

may be an early demonstration of the practical and economical use of nuclear energy for the generation of electric energy, together with such industrial and scientific products and by-products and applications as may seem desirable; and in furtherance thereof to engage in any and all of the following:

(a) To design, develop, fabricate and construct, and operate a test or developmental nuclear power reactor or reactors, or to cause that to be done, and to demonstrate that such reactor or reactors may be relied upon to provide an economical source of heat or other power to be used in the generation of electric energy, and also for other industrial, scientific, and commercial purposes, and

(b) To collect or otherwise acquire information relating to the purposes of the Company and to communicate such information to the United States Atomic Energy Commission for the use of the public, and to disseminate such information to its members and to all others who may reasonably request such information for their proper business purposes, to the extent permitted by law, and

(c) To enter into such contracts and arrangements with, and to secure such licenses from, the United States of America or its Atomic Energy Commission or any other agency or department thereof, as may be appropriate or required by law to carry out the purposes of the Company, and to contract with other persons or organizations, private or public, for them to engage in experiments, research, fabrication and construction, and any other work to advance the purposes of the Company, and

(d) To receive membership fees, dues, contributions and payments in cash or services from members or others interested

in the accomplishment of the purposes of the Company.

ARTICLE III.

Location of the first registered office is:
1100 Dime Building, Detroit 26; Wayne County, Michigan.

Postoffice address of the first registered office is:
1100 Dime Building, Detroit 26, Michigan.

ARTICLE IV.

The name of the first resident agent is:

Walker L. Cisler.

ARTICLE V.

Said corporation is organized upon a non stock basis.

The amount of assets which said corporation possess is:
Real Property: None
Personal Property: $10,000.00 in Cash

Said corporation is to be financed under the following general plan: By dues, membership fees, contributions, grants, proceeds of activities, and contracts

[5140]

entered into pursuant to the purposes of the Company.

ARTICLE VI.

The names and places of residence, or business of each of the incorporators are as follows:

(At least three required)

Names	Residence or Business Address
Prentiss M. Brown	St. Ignace, Michigan
Walker L. Cisler	2000 Second Avenue Detroit 26, Michigan
John S. Coleman	6071 Second Boulevard Detroit 2, Michigan
George M. Holley, Jr.	11955 Nine Mile Road Van Dyke, Michigan
Justin R. Whiting	212 Michigan Ave. N.W. Jackson, Michigan

ARTICLE VII.

The names and addresses of the members of the first Board of Trustees are as follows:

(At least three required)

Names	Address
Prentiss M. Brown	St. Ignace, Michigan
Walker L. Cisler	2000 Second Avenue Detroit 26, Michigan
John S. Coleman	6071 Second Boulevard Detroit 2, Michigan
George M. Holley, Jr.	11955 Nine Mile Road Van Dyke, Michigan
Justin R. Whiting	212 Michigan Ave. N.W. Jackson, Michigan

[5141].

ARTICLE VIII.

The term of the corporate existence is 30 years.

ARTICLE IX.

The Company is not to be operated for profit, and no part of the net earnings of the Company shall inure to the benefit of any member or any private individual or corporation; and no part of the activities of the Company shall consist in carrying on propaganda or otherwise attempting to participate in any political campaign or to influence legislation.

ARTICLE X.

If for any reason it is determined that this Company shall be dissolved, or if it shall otherwise cease to exist, any property remaining in its hands after the discharge of all of its obligations shall be distributed to such corporation or corporations organized and operated exclusively for educational or scientific purposes and not for profit as

the Board of Trustees may determine, to be used by such corporation or corporations solely for educational and scientific purposes to further research and development in the use of atomic energy for peaceful purposes.

[5142]

It is the intention of the incorporators that all funds and property of this Company shall be devoted to the purposes hereof and shall not revert to those furnishing it with funds; accordingly, at no time shall any property of the Company be returned to the original incorporators or other members, or to any donors or contributors.

We, the incorporators, sign our names this 24th day of August, 1955.

WALKER L. CISLER (sgd)
WALKER L. CISLER

JOHN S. COLEMAN (sgd)
JOHN S. COLEMAN

GEORGE M. HOLLEY, JR. (sgd)
GEORGE M. HOLLEY, JR.

JUSTIN R. WHITING (sgd)
JUSTIN R. WHITING

PRENTISS M. BROWN (sgd)
PRENTISS M. BROWN

State of Michigan)
County of Wayne) ss.:

On this 24th day of August, 1955, before me personally appeared Walker L. Cisler, to me known to be one of the persons described in and who executed the foregoing instru-

ment, and acknowledged that he executed the same as his free act and deed.

GERALD C. SIMON (sgd)
Notary Public, Wayne County, Michigan
My commission expires July 26, 1959

[5143]

State of Michigan)
County of Wayne) ss.:

On this 29th day of August, 1955, before me personally appeared John S. Coleman, to me known to be one of the persons described in and who executed the foregoing instrument, and acknowledged that he executed the same as his free act and deed.

GERALD C. SIMON (sgd)
Notary Public, Wayne County, Michigan
My commission expires July 26, 1959

State of Michigan)
County of Wayne) ss.:

On this 29th day of August, 1955, before me personally appeared George M. Holley, Jr., to me known to be one of the persons described in and who executed the foregoing instrument, and acknowledged that he executed the same as his free act and deed.

GERALD C. SIMON (sgd)
Notary Public, Wayne County, Michigan
My commission expires July 26, 1959

[5144]

State of Michigan)
County of Wa ne) ss.:

On this 29th day of August, 1955, before me personally appeared Justin R. Whiting, to me known to be one of the persons described in and who executed the foregoing instrument, and acknowledged that he executed the same as his free act and deed.

GERALD C. SIMON (sgd)
Notary Public, Wayne County, Michigan
My commissio expires July 26, 1959

State of Michigan)
County of Wayne) ss.:

On this 29th day of August, 1955, before me personally appeared Prentiss M. Brown, to me known to be one of the persons described in and who executed the foregoing instrument, and acknowledged that he executed the same as his free act and deed.

GERALD C. SIMON (sgd)
Notary Public, Wayne County, Michigan
My commission expires July 26, 1959

Filed with Michigan Corporation
and Securities Commission
August 30, 1955

[5410]

December 10, 1956

United States Atomic Energy Commission
Division of Licensing
Washington 25, D. C.

Gentlemen:

On January 7, 1956, we filed our application for a license under Section 104(b) of the Atomic Energy Act of 1954 to construct and operate a nuclear reactor. Amendments to this application were filed by us on June 6, 1956, July 12, 1956, July 20, 1956 and July 23, 1956. On August 4, 1956, the Commission issued a provisional construction permit authorizing construction of the reactor, subject to certain conditions. These conditions included a requirement of later submission of additional information relating to our Company's financial resources and of a complete, final Hazards Summary Report.

Thereafter, various persons intervened in this matter and on October 8, 1956, the Commission ordered that a hearing be held on a designated Specification of Issues, including the issue whether the Commission should grant any exemptions pursuant to Section 50.12 of its regulations. The hearing is now scheduled for January 8, 1957.

While we believe that our original application, as amended, is broad enough to constitute an application for temporary exemptions under Section 50.12 from certain of the Commission's regulations, subsequent developments indicate the desirability of confirming and clarifying the application by an additional amendment designating explicitly the exemptions which are requested. We have therefore includ-

ed in the attached Amendment No. 5 to our Application f
License, which is herewith submitted for filing, reques
for specific exemptions from certain of the requiremen
of Sections 50, 35, 50.40(b) and 50.60(c)(2) of the Commi
sion's regulations.

Very truly yours,

ROBERT W. HARTWELL
Assistant General Manager

RWH:eml
Enclosure:

[5411]

AMENDMENT NO. 5 TO APPLICATION FOR LICENS
UNDER
ATOMIC ENERGY ACT OF 1954

SUBMITTED BY
POWER REACTOR DEVELOPMENT COMPANY

Power Reactor Development Company submits the fo
lowing amendment to the Application for a Section 104 (
License submitted by it under date of January 6, 1956.

Amend the Application by inserting on Page 10 there
immediafely preceding the caption "Summary of App
cant's Requests" the following additional paragraph:

"Request for Exemptions under 10 C. F. R. 50.12

"1) Applicant applies for exemption from the r
quirement of 10 C. F. R. 50.35 that the Commi
sion be satisfied in connection with the issuan
of a construction permit on a provisional bas

that 'it has information sufficient to provide reasonable assurance that a facility of the general type proposed can be * * * *operated* at the proposed location without undue risk to the health and safety of the public * * *.' Applicant does not request exemption from the requirements of this Section 50.35 that the Commission be so satisfied that it has information sufficient to provide reasonable assurance that a facility of the general type proposed can be *constructed* at the proposed location without undue risk to the health and safety of the public, and that the Commission be satisfied that technical information omitted from the application will be supplied.

"2) Applicant applies for exemption from the requirements of 10 C. F. R. 50.40(b), relating to financial qualification to engage in the proposed activities, in such respects, if any, as the Commission determines to be appropriate in connection with the issuance of a construction permit on a provisional basis.

[5412]

"3) Applicant applies for exemption from the requirement of 10 C. F. R. 50.60(c)(2), relating to financial qualification to pay for and use special nuclear material, in such respects, if any, as the Commission determines to be appropriate in connection with the issuance of a construction permit on a provisional basis."

IN WITNESS WHEREOF, POWER REACTOR DEVELOPMENT COMPANY has caused its name to be here-

unto signed by John A. Lagrou, its Treasurer, and its corporate seal to be hereto affixed by John F. Anderson, its Assistant Secretary, thereunto duly authorized, this 10th day of December, 1956.

POWER REACTOR
DEVELOPMENT COMPANY

By JOHN A. LAGROU
Treasurer

ATTEST:
JOHN F. ANDERSON
Assistant Secretary

(Corporate Seal)

Attest:

[5435]

Application Exhibit XXI

AGREEMENT
BETWEEN
POWER REACTOR DEVELOPMENT, COMPANY
AND
ATOMIC POWER DEVELOPMENT
ASSOCIATES, INC.

THIS AGREEMENT entered into this 14th day of December, 1956, between POWER DEVELOPMENT COMPANY, a non-profit membership corporation organized and existing under the laws of the State of Michigan (herein called "PRDC"), and ATOMIC POWER DEVELOPMENT ASSOCIATES, INC., a non-profit membership corporation organized and existing under the laws of the State of New York (herein called "APDA");

WITNESSETH:

WHEREAS, APDA is conducting, and intends to continue to conduct, a research and development program relative to the utilization for power purposes of atomic reactors, especially of the type known as a fast neutron breeder reactor;

WHEREAS, the purpose of PRDC is to construct and operate a developmental sodium cooled fast neutron breeder reactor and requisite appurtenant facilities (hereinafter called the "Reactor Plant"), and to thereafter operate the Reactor Plant to study, establish and demonstrate its technology and practical value;

WHEREAS, APDA has developed a conceptual design of a reactor plant and, accordingly, is interested in the demonstration of the application of such design; and

WHEREAS, the program of PRDC will provide for purposes of study by APDA and others a reactor plant in the nature of a laboratory for the demonstration of the science and technology of a fast neutron breeder reactor, such plant to be constructed in response to the Power Demonstration Reactor Program of the Atomic Energy Commission (herein called "AEC").

NOW, THEREFORE, in consideration of the premises and of the mutual undertakings hereinafter set forth, the parties agree as follows:

ARTICLE I—REACTOR DESIGN SERVICES

A. APDA will furnish to PRDC without charge a complete design for those components of the Reactor Plant within and including the secondary containment vessel and for the primary coolant loops,

which collectively are herein referred to as the "reactor proper" as identified on Exhibits A and B of this agreement.

B. In connection with and as incident to the furnishing of a design for the reactor proper, APDA agrees to transfer to PRDC certain equipment and devices (consisting principally of a reactor vessel, a rotating shield plug, handling and control devices and a primary coolant system) which APDA expects to assemble and to test for suitability of design, mechanical performance, hydraulic characteristics, thermal stress information and similar data. Such equipment and devices will be transferred after tests have been completed by APDA and at a time to be agreed upon between the parties, upon written request by PRDC at some time after receipt by PRDC of a construction permit under the Atomic Energy Act of 1954 (herein called "the Act"). Such equipment and devices will be transferred on a "where-is, as-is" basis and APDA will be compensated therefor on the basis of the salvage value of such equipment and devices as determined by agreement of the parties. APDA makes no warranty, express or implied, as to the completion of such equipment and devices, their condition or suitability for incorporation in the Reactor Plant.

C. APDA will also furnish to PRDC copies of designs, drawings and documents relating to the aforesaid equipment and devices, tests performed thereon and modifications in such equipment and devices made in the course of testing.

D. APDA agrees to furnish necessary engineering information to enable PRDC to purchase the additional equip-

ment needed to adapt the aforesaid equipment and devices to the Reactor Plant to the extent such aforesaid equipment and devices are part of the reactor proper. APDA also agrees to furnish specifications for modification of the aforesaid equipment and devices necessary to adapt them to the Reactor Plant.

E. APDA agrees to furnish (a) detailed specifications for the fuel and blanket subassemblies of the Reactor Plant; and (b) reactor physic and control studies performed by or for APDA pertaining to a fast neutron breeder reactor.

ARTICLE II—TECHNICAL AND CONSULTING SERVICES

A. In addition to the work called for in Article I hereof APDA agrees to provide technical services, including preliminary designs and necessary studies incident thereto, in connection with the following components of the Reactor Plant:

1. Shielding
2. Fuel element transfer and decay equipment
3. Gas systems, including the shield cooling system, gas seal systems and building ventilation system

[5437]

4. Foundations for reactor building
5. Reactor Building
6. Control room
7. Secondary coolant system (including heat exchangers and boilers)
8. Plant instrumentation (including control panels)

9. Pre-shipment processing facility
10. Other reactor components

B. APDA also agrees to provide consulting services to PRDC including, but not limited to, the following:

1. Review of preliminary drawings prepared by other contractors for PRDC on the basis of preliminary designs prepared by APDA.
2. Review of final designs to the extent necessary to make recommendations on the functional operation of equipment covered by such designs.
3. Liaison with the contractors of AEC in connection with research and development work done by the AEC or its contractors for PRDC.
4. Advise on other research and development work done by or for PRDC.
5. Assistance in preparation of material relating to hazards and safety of the Reactor Plant.
6. An outline of the general scope of the procedure for the operation of the Reactor Plant.

ARTICLE III—LIMITATIONS ON APDA OBLIGATIONS AND LIABILITY

A. The obligations of APDA hereunder are subject to availability of funds under its established budget procedures, except as the parties may otherwise agree.

B. In the performance of the services contemplated in Articles IA, IC and II hereof, APDA shall be held to the standard of care customary in the performance of such services.

C. PRDC hereby indemnifies and holds harmless APDA from any claim or cause of action (1) arising after the

transfer of the equipment and devices referred to in Article IB and asserted against

[5438]

APDA by reason of the nature, manufacture, assembly or performance of such equipment and devices; and (2) asserted against APDA by third persons by reason of the design, construction or operation of the Reactor Plant.

ARTICLE IV—INSURANCE

PRDC shall carry, at its expense, bodily injury and property damage liability insurance (covering APDA, as its interest may appear) which may be made available in connection with the operation of the Reactor Plant and enter into an indemnification agreement with AEC, if and to the extent Government indemnification is available, to implement the indemnification obligations of PRDC under Article III hereof.

ARTICLE V—ASSIGNMENT OF PERSONNEL

Scientific and technical personnel of PRDC or PRDC member companies may be assigned to APDA for training and assistance and to work on the APDA program. Each proposal to make such an assignment shall be separately submitted and APDA may in the reasonable exercise of its discretion accept or reject the individual proposed to be assigned. APDA will enter into separate agreements covering each individual so assigned with each such individual's employing company. Employees assigned hereunder shall be under the exclusive technical and administrative control of APDA throughout the period of assignment.

ARTICLE VI—EXCHANGE OF INFORMATION

APDA and PRDC will provide each other all such technical, scientific, operational, economic or other information which may be developed by themselves or their various contractors which is pertinent to the respective programs of either party. PRDC may make all such information available to AEC, as required by AEC. APDA and PRDC agree to keep and cause their contractors to keep records of all such information.

ARTICLE VII—PATENTS

A. The parties mutually recognize that the provisions of their respective by-laws contemplate the free dissemination of information gained by the parties hereto in their respective programs and further recognize that any patents acquired by either of the parties in the course of their programs are freely available to each other, to their respective member companies and to the public, subject only to the authority of the AEC.

B. No claim for pecuniary award or compensation under the provisions of the Act shall be made by APDA or PRDC, their employees, agents or others with respect to any invention or discovery made or conceived in the course of any of the work under this agreement.

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C. Both ADPA and PRDC will execute all documents and instruments and do all things, including obtaining such agreements from their respective employees, contractors, member companies and agents as may be necessary or proper to effectuate the purposes hereinabove set forth.

ARTICLE VIII—ASSIGNMENT

This agreement shall not be assigned by either party hereto without the written consent of the other party.

ARTICLE IX—GENERAL RESTRICTION

All the agreements and covenants hereunder are subject to the provisions of the Act.

IN WITNESS WHEREOF, the parties hereto have caused these presents to be executed, and their respective seals to be affixed, by their officers thereunto duly authorized, on the day and year first above written.

POWER REACTOR
DEVELOPMENT COMPANY

By R. G. Rincliffe,
Executive Vice President

Attest:
George E. Olmsted
Secretary
Power Reactor Development Company

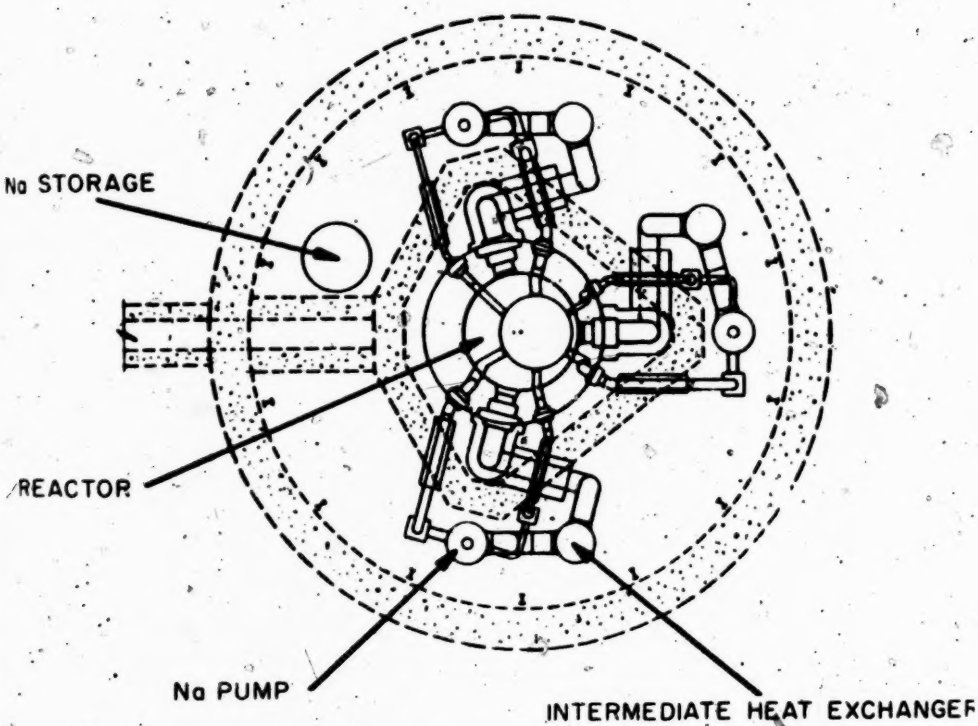
ATOMIC POWER DEVELOPMENT ASSOCIATES, INC.

By J. F. Fairman
Vice President

Attest:
Alvin E. Upton
Secretary
Atomic Power Development Associates, Inc.

[5440]

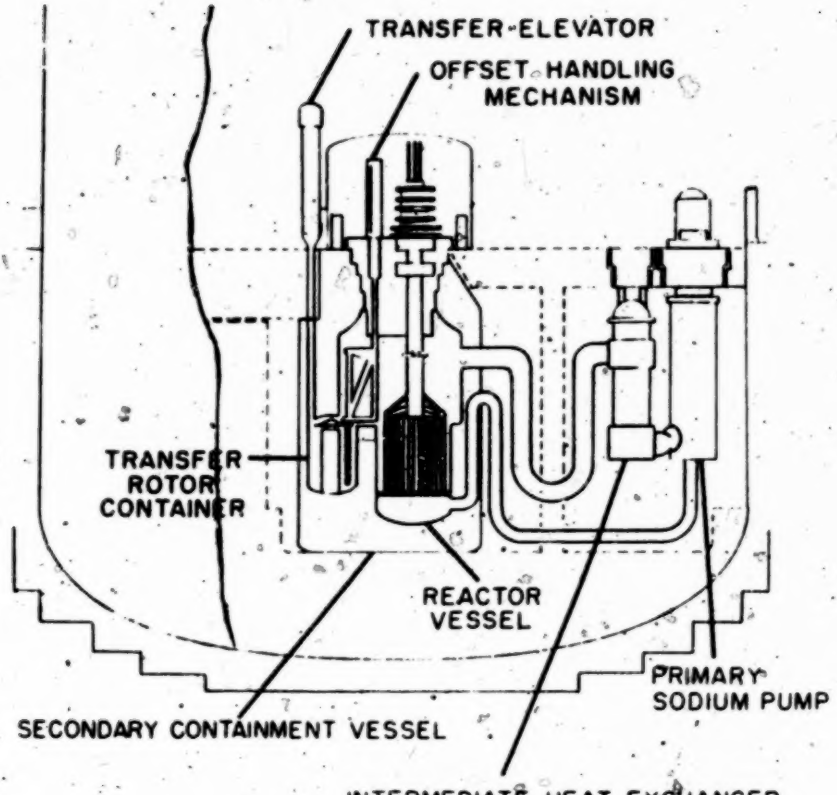
EXHIBIT A



PLAN VIEW OF "REACTOR PROPER" SYSTEM

[5441]

EXHIBIT B



ELEVATION VIEW OF "REACTOR PROPER" SYSTEM

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Application Exhibit XXII

[CONFORMING COPY]

LOAN AGREEMENT

AGREEMENT dated October 30, 1956 between POWER REACTOR DEVELOPMENT COMPANY, a membership corporation organized under the laws of Michigan (the "Company"); J. P. MORGAN & CO. INCORPORATED, a New York corporation, BANKERS TRUST COMPANY, a New York corporation, THE CHASE MANHATTAN BANK, a New York corporation, THE FIRST NATIONAL CITY BANK OF NEW YORK, a national banking association, and CITY BANK FARMERS TRUST COMPANY, a New York corporation, each acting severally and not jointly as trustee of various pension trusts, and BANKERS TRUST COMPANY as Trustee under agreement with American Brake Shoe Company dated May 17, 1940 (the "Banks"); and J. P. MORGAN & CO. INCORPORATED, as Agent for all the Banks (the "Agent").

WITNESSETH:

SECTION 1. *Representation and Warranty*

The Company represents and warrants that it is a duly existing membership corporation validly organized and existing in good standing under the laws of the State of Michigan and the execution and delivery of this Agreement and of the Notes herein provided for are within its corporate authority, have been authorized by proper corporate

proceedings, and will not contravene any provision of law or of its charter, by-laws or any agreement or other instrument binding upon it.

SECTION 2. *The Loans*

2.1. *Total Loans.* Subject to the provisions of this Agreement, each Bank, acting in the capacity indicated above, agrees to make loans to the Company from time to time on or prior to December 31, 1958 in an aggregate principal amount not exceeding the amount set forth below opposite the name of such Bank:

J. P. Morgan & Co. Incorporated	$ 3,750,000
Bankers Trust Company	3,675,000
The Chase Manhattan Bank	3,750,000
The First National City Bank of New York	2,025,000
City Bank Farmers Trust Company	1,725,000
Bankers Trust Company as Trustee under agreement with American Brake Shoe Company dated May 17, 1940	75,000
	$15,000,000

2.2. *Borrowings.* The Company agrees that it will borrow from the Banks, *pro rata* in accordance with their respective commitments, at the following times and in the following amounts:

(a) Not less than $2,000,000 on each of the following dates: March 31, June 30, September 30, and December 31, 1957; and

(b) Not less than $1,750,000 on each of the following dates: March 31, June 30, September 30 and December 31, 1958.

At its option and upon not less than 65 days' written notice to the Agent, which shall give 60 days written notice to each Bank, the Company may borrow from the Banks, *pro rata* in accordance with their respective commitments, on one or more of the above borrowing dates an additional amount (in a multiple of $100,000), such additional amount not to exceed $1,000,000 at any one time. Each additional borrowing shall reduce

the Banks' commitments *pro rata* and the Company's borrowing obligations set forth above in the inverse order of the dates for such borrowings.

All loans under this Agreement shall be evidenced by Notes substantially in the form of Annexes A and B hereto.

2.3. *Maturity and Interest Rate.* Each Note shall be dated the date of the borrowing, shall mature on July 1, 1970 and shall bear interest (on the basis of a 360-day year) at the rate of 4.35% per annum until maturity, payable semi-annually on each January 1 and July 1.

2.4. *Conditions to Loans.* The obligation of each Bank to make loans hereunder is subject to the receipt by such Bank of:

(a) A duly executed Note or Notes for the amount then being loaned by such Bank;

(b) A certificate dated the date of the borrowing and signed by the President or a Vice President and the Secretary or Treasurer or an Assistant Secretary or Assistant Treasurer of the Company to the effect that (i) no event of default specified in Section 5, and

no event which with the passing of time or giving of notice, or both, would occasion such an event of default has occurred and is continuing, (ii) the representation and warranty contained in Section 1 hereof is then true and correct, (iii) the Operating Agreement between the Company and the Atomic Energy Commission and the Steam Agreement between the Company and The Detroit Edison Company referred to in Section 4.2 have been duly executed and are in full force and effect, (iv) the orders, approvals and authorizations of governmental administrative agencies or other regulatory bodies specified in the opinions then required to be delivered pursuant to clause (vi) of paragraph (d) and clause (iii) of paragraph (f) of this Section 2.4 are in full force and effect and no proceedings to amend or rescind such orders are, to the knowledge of the signers, pending or threatened and (v) no litigation materially affecting the Company or the validity of this Agreement or the Notes or the Guaranty Agreement referred to in paragraph (c) of this Section 2.4 is, to the knowledge of the signers, pending or threatened, except as stated in said certificate;

(c) A counter part of a Guaranty Agreement (hereinafter called the "Guaranty Agreement") substantially in the form of Annex C hereto duly executed by the respective guarantors for the respective percentages set forth in said Annex C, or with such changes in guarantors and percentages as may be approved by the Banks;

(d) An opinion of Miller, Canfield, Paddock & Stone, counsel for the Company, or of other counsel

for the Company acceptable to the Banks, satisfactory to special counsel for the Banks, to the effect that (i) the Company is a duly existing membership corporation validly organized and in good standing under the laws of the State of Michigan, (ii) this Agreement has been duly authorized, executed and delivered by the Company and is its valid and binding obligation in accordance with its terms and is not in contravention of the certificate of incorporation or by-laws of the Company, (iii) the execution and delivery of this Agreement and the Notes are not in contravention of law or of any agreement or other instrument to which the Company is a party or by which it is bound, (iv) the Notes have been duly authorized, executed and delivered and constitute the valid and binding obligations of the Company in accordance with their terms, (v) the Guaranty Agreement has been duly authorized, executed and delivered by the guarantors and constitutes the valid and binding several obligation of each of the guarantors in accordance with its terms,

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(vi) all orders, approvals and authorizations (which shall be specified) of governmental administrative agencies or other regulatory bodies required in connection with the execution and delivery of this Agreement or of the Notes have been obtained and are in full force and effect;

(e) An opinion of special counsel for the Banks, to the effect specified in clauses (ii), (iv) and (v) of paragraph (d) above;

(f) An opinion of counsel for each guarantor, satisfactory to special counsel for the Banks, to the effect that (i) such guarantor is a duly existing corporation validly organized and in good standing under the laws of its state of incorporation, (ii) the Guaranty Agreement has been duly authorized, executed and delivered by such guarantor and is the valid and binding obligation of such guarantor in accordance with the terms of the Guaranty Agreement and is not in contravention of the certificate of incorporation or by-laws of such guarantor, or, to the best of such counsel's knowledge or belief, in contravention of any agreement or other instrument to which such guarantor is a party or by which it is bound, and (iii) all orders, approvals and authorizations (which shall be specified) of governmental administrative agencies or other regulatory bodies required in connection with the execution and delivery of the Guaranty Agreement by such guarantor have been obtained and are in full force and effect; and

(g) Photostatic copies of all orders, approvals and authorizations of governmental administrative agencies or other regulatory bodies specified in the opinions then required to be delivered pursuant to clause (vi) of paragraph (d) and clause (iii) of paragraph (f) of this Section 2.4.

In giving their opinions with respect to the validity of the Guaranty Agreement, Miller, Canfield, Paddock & Stone and special counsel for the Banks may rely, to the extent stated in their opinions, upon the opinions of counsel for the respective guarantors; provided that such

firm and special counsel shall make an independent review of the power and authority of the several guarantors to execute the Guaranty Agreement under the laws of their respective States of incorporation, their documents of incorporation and by-laws and their corporate resolutions and proceedings and shall so state in their opinions as to the validity of the Guaranty Agreement.

The obligation of each Bank to make loans hereunder is also subject to the condition that, if any litigation is specified in the certificate furnished pursuant to paragraph (b) of this Section 2.4, such litigation shall not, in the judgment of such Bank, be of such a character as to materially and adversely affect the value of the Notes as obligations of the Company guaranteed under the Guaranty Agreement or as to raise any material questions as to the validity of the Notes of the guaranties under the Guaranty Agreement.

2.5 *Termination of Commitment to Borrow.* At any time prior to the making of all loans provided for herein the Company may, on not less than 35 days' written notice to the Agent, which shall give 30 days' written notice to each Bank, elect to terminate its obligation to borrow under this Agreement, subject, however, to the following conditions:

(a) Such termination may not be effected from or in anticipation of moneys obtained or borrowed by or for the account of the Company at an effective rate (calculated in accordance with accepted financial practice) of less than 4.35% per annum, provided, however, that nothing herein contained shall be construed to prohibit

the effectuation of such termination with moneys obtained from contributions of members of the Company; and

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(b) No notice of election to terminate shall be effective unless upon the date fixed for termination of its obligation to borrow hereunder, the Company shall pay to the Agent for the account of each Bank funds sufficient to pay

(i) the commitment fee of such Bank accrued to the date fixed for termination of the commitment to borrow;

(ii) the principal amount of any Notes issued to such Bank and outstanding on the date of such termination, together with accrued interest thereon to the date fixed for termination of the commitment to borrow; and

(iii) an amount equal to 90 days' interest at the rate of 4.35% per annum (computed on a 360-day year basis) on the principal amount of any Notes issued to such Bank and outstanding on the date of such termination.

2.6. *Repayment of Loans.* If all the borrowings provided for in this Agreement are made, the Company agrees to make the following aggregate payments on the dates indicated in respect of the principal of the Notes outstanding on such dates:

(a) $1,000,000 on each January 1 and July 1 in the years 1964 to 1969, both dates inclusive; and

(b) $1,500,000 on January 1 and July 1, 1970.

2.7. *Prepayment of Loans.* If all the borrowings provided for in this Agreement are made the Company may, upon not less than 45 days written notice to the Agent, which shall give 40 days written notice to each Bank, prepay the Notes on the following terms:

(a) If prior to completion thereof the trustees of the Company elect to abandon construction of its plant at Monroe, Michigan, or if the Atomic Energy Commission exercises its right to acquire such plant pursuant to the terms of its proposed Operating Agreement with the Company, the Company may prepay all, but not a part, of the Notes at their principal amount and accrued interest to the date of prepayment; provided, however, that if such prepayment is made on or prior to December 31, 1958 the Company shall pay in addition an amount equal to 90 days' interest at the rate of 4.35% per annum (computed upon a 360-day year basis) on the principal amount of the Notes so prepaid;

(b) After December 31, 1958 the Company may prepay all, but not a part, of the outstanding Notes at the following percentages of their principal amount:

If prepaid during the 24 months ended December 31,

Year	*Percentage*
1960	104.35
1962	103.48
1964	102.61
1966	101.74
1968	100.87

and thereafter at 100%, in each case together with accrued interest to the date of prepayment. No such

prepayment may be effected, directly or indirectly, from or in anticipation of moneys obtained or borrowed by the Company at an effective rate (calculated in accordance with accepted financial practice) of less than 4.35% per annum; provided, however, that nothing herein contained shall be construed to prohibit such prepayment with moneys obtained from contributions of members of the Company.

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2.8. *Payments of Principal and Interest and Premium.* Payments of principal of and interest and premium, if any, on the Notes shall be made by the Company to the Agent for the account of the holders of the Notes and the Agent shall make distribution thereof among such holders. Payments so made by the Company to the Agent shall constitute a full discharge of the Company's liability with respect to, and each noteholder's right as against the Company to receive, its proportionate share of the amounts so paid. If any payment shall constitute payment in full of the principal of any Note, such payment shall be made by the Agent to the holder of the Note only upon surrender of such Note to the Agent. Any Note so surrendered to it shall be marked "Paid" by the Agent and delivered to the Company. The amount of any partial payment of principal on any Note shall be endorsed upon such Note by the holder thereof.

SECTION 3. *Commitment Fee*

In consideration of the Banks' several agreements to make the loans hereunder, the Company agrees to pay

to the Agent for the account of the Banks (i) on March 31, 1957 an amount equal to ½ of 1% per annum (computed on a 360-day year basis) on the Banks' respective commitments hereunder from July 1, 1956 to and including March 31, 1957 and (ii) on each borrowing date after March 31, 1957 an amount equal to ½ of 1% per annum on such portion of the Banks' respective commitments as is not evidenced by Notes executed and delivered prior to such borrowing date, computed from the last preceding borrowing date on a 360-day year basis.

SECTION 4. *Covenants.*

Until payment in full of the Notes, the Company agrees that:

4.1. *Financial Information.* It will furnish to the Agent for the account of each Bank, so long as it holds any Notes,

(a) Not later than 60 days after the end of each of the first three quarterly periods in each fiscal year, six copies of (i) statements of receipts and disbursements and of excess of receipts over disbursements of the Company and of statements of profit and loss of each of the guarantors of the Notes for that period, and (ii) a statement of financial condition of the Company as at the end of that period, setting forth in each case in comparative form the corresponding figures for the corresponding period of the preceding fiscal year, all in reasonable detail and certified, in the case of the Company statements, by an authorized financial officer of the Company and, in the case of the guarantors' statements, by an authorized financial

officer thereof, subject in each case to year-end adjustments;

(b) Not later than 120 days after the end of each fiscal year, six copies of (i) statements of receipts and disbursements and of excess of receipts over disbursements of the Company and of statements of profit and loss of each of the guarantors of the Notes for such year, and (ii) a statement of financial condition of the Company and balance sheets of each of the guarantors of the Notes as at the end of such year, setting forth in each case in comparative form the corresponding figures of the previous annual audit, all in reasonable detail and certified by independent public accountants of nationally recognized standing; and

(c) From time to time such additional information regarding its financial condition or business as the Agent, acting on behalf of itself or any Bank, may reasonably request.

The information required in paragraph (b) above with respect to any guarantor may be furnished by delivering to the Agent six copies of the annual report to stock-

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holders of such guarantor provided any of such guarantor's securities are listed on the New York Stock Exchange. The Agent agrees to make prompt distribution to each Bank of the information received pursuant to this section.

4.2. *Negative Pledge.* It will not create or suffer to exist any pledge, mortgage or other lien on any of its assets (including its proposed Operating Agreement with

the Atomic Energy Commission and its proposed Steam Agreement with The Detroit Edison Company) now or hereafter owned, other than (a) liens in connection with workmen's compensation and other statutory obligations or encumbrances incurred in the ordinary course of business and (b) liens incidental to the conduct of its business or the ownership of its property which were not incurred in connection with the borrowing of money or the obtaining of advances or the voluntary securing of obligations of the Company and which do not in the aggregate materially detract from the value of its property or materially impair the use thereof in the operation of its business.

4.3. *Borrowed Money.* It will not incur or be obligated upon, either directly or indirectly by way of guaranty, suretyship, or otherwise, any indebtedness for borrowed money or advances other than (a) the Notes, (b) indebtedness for money borrowed otherwise than from members of the Company not exceeding $5,000,000 in the aggregate at any one time outstanding provided all such indebtedness is guaranteed as to principal and interest by all or some of the guarantors of the Notes under a form of guaranty substantially similar to the Guaranty Agreement, (c) indebtedness to members of the Company or others for advances or loans provided such indebtedness is subordinated to the Notes and any indebtedness permitted by clause (b) of this Section 4.3. in accordance with or in substantially the same terms as provided in the Guaranty Agreement with respect to subordinated indebtedness, and (d) indebtedness for other money borrowed, not exceeding $2,000,000 at any one time outstanding, provided all such indebtedness matures on demand or within one year after the date it is

incurred and is not renewable or extendable at the option of the Company for a period ending more than one year after the date it is incurred and is not payable from the proceeds of other indebtedness which may be incurred pursuant to the provisions of any revolving credit agreement or other similar agreement.

4.4. *Appointment of Trustee.* Upon the request in writing of the holders of 66⅔% in principal amount of the Notes outstanding, the Company will appoint a trustee in respect of the Notes and will execute and deliver an indenture containing substantially the same provisions, where appropriate, as this Agreement and such additional provisions as are customary in instruments of such character. Concurrently with the execution of said indenture the Company will execute and will arrange for the authentication by said trustee of new notes issued under said indenture and will exchange said notes for equal aggregate principal amounts of the Notes upon surrender thereof.

SECTION 5. *Defaults*

5.1. *Events of Automatic Default.* In the event that

(a) the Company shall fail to pay any Note when due, or any instalment of interest thereon within 10 business days after the due date thereof; or

(b) the Company shall fail to observe or perform any term, covenant or agreement contained in any agreement or obligation by which it is bound and which evidences borrowed money, other than subordinated indebtedness permitted hereunder, for such period of time as would accelerate, or would permit the holder

thereof or of any obligations issued thereunder, to accelerate, the maturity thereof or of any obligation issued thereunder; or

(c) the Company shall admit in writing its inability to pay its debts; or suffer a receiver or trustee for it or substantially all of its property to be appointed and if appointed without its consent not to be discharged within 30 days; or suffer proceedings under any law relating to bankruptcy, insolvency or the reorganization or relief of debtors to be instituted by or against it, and if contested by it not to be dismissed or stayed within 60 days; or suffer any writ of attachment or execution or any similar process to be issued or levied against substantially all of its property or suffer any judgment to be entered against it in an amount in excess of $100,000 which is not released, satisfied, stayed, bonded or vacated within 30 days after its issue, levy or entry;

then, and in every such event, the Notes shall forthwith become due and payable without presentment, demand, protest or other notice of any kind, all of which are hereby expressly waived.

5.2. *Other Events of Default.* In the event that

(a) the Company shall fail to perform any covenant or agreement herein contained (other than those specified in clause 5.1(a) above) for 30 days after written notice of default has been given to it by any of the Banks or by the Agent; or

(b) the Company shall have made any representation or warranty in Section 1 which shall prove to

have been false in any material respect at the date as of which given; or

(c) the Company shall fail to observe or perform any term, covenant or agreement contained in any agreement or obligation by which it is bound and which evidences subordinated indebtedness permitted hereunder for such period of time as would accelerate, or would permit the holder thereof or of any obligations issued thereunder to accelerate, the maturity thereof or of any obligation issued thereunder;

then and in every such event any of the Banks may, or upon receipt of a request in writing or by telegraph from the holder of any Note the Agent shall, by written or telegraphic notice to the Company shall declare all Notes outstanding to be and they shall thereupon forthwith become due and payable without presentment, demand, protest or other notice of any kind, all of which are hereby expressly waived. The Agent shall forthwith notify all holders of Notes of the taking of any such action by it. Any Bank giving notice pursuant to paragraph (a) above shall send a copy of such notice to each of the other Banks and to the Agent which, if there are other holders of Notes, shall thereupon send copies thereof to each such holder.

SECTION 6. *The Agent*

6.1. *Appointment of Agent.* Each of the Banks hereby appoints, and each subsequent holder of Notes by his acquisition thereof shall be deemed irrevocably to have appointed J. P. Morgan & Co. Incorporated as Agent, to accept payments of commitment fees and payments on account of principal of or interest and premium, if any, on the Notes and to take such action on its behalf and to

exercise such powers hereunder and under the Guaranty Agreement as are specifically delegated to it by the terms hereof and of said Guaranty Agreement, together with such powers as are reasonably incidental thereto. The Agent shall not be responsible to any holder of Notes for any recitals or statements

or warranties or representations herein or in the Guaranty Agreement or be bound to ascertain or inquire as to the performance or observance of any of the terms, conditions, covenants or agreements on the part of the Company to be performed pursuant to this Agreement or the Guaranty Agreement or on the part of said guarantors to be performed pursuant to the Guaranty Agreement and neither it nor any of its directors, officers or agents shall be liable for any action taken or omitted to be taken in connection herewith or in connection with the Guaranty Agreement except for their own negligence or willful misconduct.

6.2. *Payments to Agent.* The Company will reimburse the Agent for all reasonable out-of-pocket expenses (including fees and disbursements of special counsel for the Banks) incurred by it in connection with this Agreement and the Guaranty Agreement and the loans made under this Agreement, and will pay any taxes, assessments or charges (including penalties and interest) assessed or made by any governmental authority by reason of the execution and delivery of this Agreement or of the Notes to be executed and delivered hereunder or the execution and delivery of the Guaranty Agreement.

SECTION 7. *Miscellaneous*

7.1. *Notices.* Except where otherwise provided, notices, statements, requests and demands hereunder shall be deemed to have been given or made when mailed or delivered to the telegraph company, addressed to the addressee at its address given below:

Power Reactor Development Company	1911 First Street Detroit 26, Michigan
J. P. Morgan & Co. Incorporated	23 Wall Street New York 8, N. Y.
Bankers Trust Company	16 Wall Street New York 15, N. Y.
The Chase Manhattan Bank	18 Pine Street New York 15, N. Y.
The First National City Bank of New York	55 Wall Street New York 15, N. Y.
City Bank Farmers Trust Company	22 William Street New York 15, N. Y.
Bankers Trust Company As Trustee under agreement with American Brake Shoe Company dated May 17, 1940	16 Wall Street New York 15, N. Y.

7.2. *Obligations of Banks Several.* The obligations of the Banks hereunder are several and not joint and no provision hereof shall be deemed to constitute any of the parties hereto a partnership, association or other entity.

7.3. *New York Law.* This Agreement and the Notes shall be deemed to be contracts made under and shall be

construed in accordance with and be governed by the laws of the State of New York.

7.4. *Changes, Waivers, etc.* At the request of the Company and with the consent of the holders of not less than 66⅔% in aggregate principal amount of the Notes at the time outstanding, this Agreement may be amended for the purpose of adding any provisions hereto or changing in any manner or eliminating any of the provisions hereof or for the purpose of modifying in any manner the rights of the holders of the Notes; provided, however, no such amendment shall (a) extend the fixed maturity of any Note or the earlier repayments required by Section 2.6, or reduce the principal amount thereof, or

reduce the rate or extend the time of payment of interest thereon without the consent of the holder of each Note so affected, or (b) reduce the aforesaid percentage of Notes, the consent of the holders of which is required for any such amendment, without the consent of the holders of all Notes then outstanding. No failure or delay by the holder of any Note or by the Agent in exercising any right, power or privilege hereunder or under the Guaranty Agreement shall operate as a waiver thereof, nor shall any single or partial exercise thereof preclude any other or further exercise thereof or the exercise of any other right, power or privilege.

7.5. *Exchange of Notes.* At the option of any holder thereof, a Note or Notes may be exchanged for two or more Notes of like tenor in an aggregate principal amount equal to the unpaid balance of the Notes surrendered and

the Company agrees to execute and deliver such Notes upon request of such holder.

7.6. *Investment Representations.* Each of the Banks represents that it is purchasing its proportionate share of the Notes for the account of certain pension trusts for investment and not with a view to, or for sale in connection with, the distribution of Notes or interests or participations therein nor with any present intention of distributing or selling such Notes or interests or participations.

7.7. *No Recourse.* It is an express condition of this Agreement that, except as provided in the Guaranty Agreement, no recourse whatsoever shall be had under this Agreement against any member, officer, director or employee as such of, or contributor to, the Company, or of any successor corporation, either at law or in equity, and whether by the enforcement of any assessment or penalty or by virtue of any statute, constitution or rule of law, or otherwise. All such rights and claims are expressly waived and released as a condition of and in consideration for the execution of this Agreement.

In Witness Whereof, the parties hereto have executed this Agreement as of the day and year above set forth.

Power Reactor Development Company

By Walker L. Cisler
President

J. P. Morgan & Co. Incorporated
As Trustee of various pension trusts

By L. S. Haskins
Vice President

BANKERS TRUST COMPANY
As Trustee of various pension trusts

By C. WADSWORTH FARNUM
Vice President

THE CHASE MANHATTAN BANK
As Trustee of various pension trusts

By JAMES J. O'BRIEN
Asst. Vice President

THE FIRST NATIONAL CITY BANK
OF NEW YORK
As Trustee of various pension trusts

By H. B. MACADAMS
Vice President

CITY BANK FARMERS TRUST COMPANY
As Trustee of various pension trusts

By H. B. MACADAMS
Vice President

BANKERS TRUST COMPANY
As Trustee under agreement with
American Brake Shoe Company
dated May 17, 1940

By C. WADSWORTH FARNUM
Vice President

J. P. MORGAN & CO. INCORPORATED
As Agent

By JOHN M. MEYER, JR.
Sr. Vice President

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ANNEX A

[FORM OF FACE OF NOTE]

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On July 1, 1970, for value received, POWER REACTOR DEVELOPMENT COMPANY (herein called the "Company") a membership corporation organized under the laws of the State of Michigan, promises to pay to the order of at the office of J. P. Morgan & Co. Incorporated, Agent, 23 Wall Street, New York 8, N. Y. the principal sum of $ in lawful money of the United States and to pay interest thereon from the date hereof until maturity in like money at said office at the rate of 4.35% per annum (on the basis of a 360-day year) on the first days of January and July in each year.

This Note is one of the Notes referred to in the Loan Agreement dated October 30, 1956 between the undersigned and J. P. Morgan & Co. Incorporated, Bankers Trust Company, The Chase Manhattan Bank, The First National City Bank of New York, City Bank Farmers Trust Company, each acting as Trustee of various pension trusts, Bankers Trust Company as Trustee under Agreement with American Brake Shoe Company dated May 17, 1940, and J. P. Morgan & Co. Incorporated, as Agent, to which reference is made for the terms and provisions thereof, and for additional rights and limitations of such rights of the maker and payee hereof thereunder, including, but without limitation, provisions for making payments of principal,

interest and premium, with respect hereof, to the Agent for the account of the holder hereof, provisions for mandatory payments on account of the principal hereof and provisions for the optional prepayment hereof by the Company and for the acceleration of the maturity hereof on the occurrence of certain events as therein specified. Said Loan Agreement contains provisions for the amendment thereof at the request of the Company and with the consent of the holders of not less than 66⅔% in aggregate principal amount of the Notes at the time outstanding for the purpose of adding provisions to or changing provisions of said Loan Agreement or for the purpose of modifying in any manner the rights of the holders of the Notes; provided, however, no such amendment shall (a) extend the fixed maturity of any Note or the earlier repayments required by Section 2.6 of said Loan Agreement, or reduce the principal amount thereof, or reduce the rate or extend the time of payment of interest thereon without the consent of the holder of each Note so affected, or (b) reduce the aforesaid percentage of Notes, the consent of the holders of which is required for any such amendment, without the consent of the holders of all Notes then outstanding.

At the option of the holder hereof, this Note may be exchanged for two or more Notes of like tenor in an aggregate principal amount equal to the unpaid balance of this Note and the Company agrees to execute and deliver such Notes to the holder hereof upon request.

POWER REACTOR DEVELOPMENT COMPANY

By .....

ANNEX B

[Form of Reverse of Note]

By a Guaranty Agreement dated , 1956 with the banks named on the face hereof, the Company and J. P. Morgan & Co. Incorporated, as Agent, each of the following companies has severally and unconditionally guaranteed the due and punctual payment of the percentage set opposite its name below of the principal of and interest of this Note and each of the Notes referred to in the Loan Agreement described on the face hereof and of the indebtedness represented thereby as and when the same shall respectively become due and payable, whether at maturity of by declaration or otherwise pursuant to the terms of the Notes and Loan Agreement:

Name of Guarantor	*Percentage Guaranteed*
Central Hudson Gas & Electric Corporation	.80
The Cincinnati Gas & Electric Company	1.00
Columbus and Southern Ohio Electric Company	1.00
Consumers Power Company	10.00
Delaware Power & Light Company	1.20
The Detroit Edison Company	58.84
Iowa-Illinois Gas and Electric Company	.48
Long Island Lighting Company	2.48
Philadelphia Electric Company	10.00
Potomac Electric Power Company	3.20
Rochester Gas and Electric Corporation	1.80
The Southern Company	8.00
Wisconsin Electric Power Company	1.20

[5448]

ANNEX C

[FORM OF GUARANTY AGREEMENT]

GUARANTY AGREEMENT

Guaranty Agreement dated , 1956 between CENTRAL HUDSON GAS & ELECTRIC CORPORATION, THE CINCINNATI GAS & ELECTRIC COMPANY, COLUMBUS AND SOUTHERN OHIO ELECTRIC COMPANY, CONSUMERS POWER COMPANY, DELAWARE POWER & LIGHT COMPANY, THE DETROIT EDISON COMPANY, IOWA-ILLINOIS GAS AND ELECTRIC COMPANY, LONG ISLAND LIGHTING COMPANY, PHILADELPHIA ELECTRIC COMPANY, POTOMAC ELECTRIC POWER COMPANY, ROCHESTER GAS AND ELECTRIC CORPORATION, THE SOUTHERN COMPANY, WISCONSIN ELECTRIC POWER COMPANY, each acting severally and not jointly and herein called the "Guarantors"; J. P. MORGAN & CO. INCORPORATED, BANKERS TRUST COMPANY, THE CHASE MANHATTAN BANK, THE FIRST NATIONAL CITY BANK OF NEW YORK, CITY BANK FARMERS TRUST COMPANY, each acting severally and not jointly as trustee of various pension trusts, and BANKERS TRUST COMPANY as Trustee under agreement with American Brake Shoe Company dated May 17, 1940, herein called the "Banks"; J. P. MORGAN & CO. INCORPORATED, as Agent for all the Banks, herein called the "Agent"; and POWER REACTOR DEVELOPMENT COMPANY, herein called the "Company".

WHEREAS, the Company has executed and delivered to the Banks and the Agent a Loan Agreement dated October 30, 1956, in the form of Exhibit A hereto, herein called the "Loan Agreement", and proposes to borrow thereunder $15,000,000 to be evidenced by its promissory notes (being in the form set forth in Exhibit A and herein called the "Notes") maturing July 1, 1970 and bearing interest at 4.35% per annum; and

WHEREAS, each of the Guarantors is a member or a parent of a member of the Company or a contributor to the Company and each of the Guarantors is interested in furthering the work of the Company; and

WHEREAS, in order to induce each of the Banks and the Agent to execute said Loan Agreement and to induce the Banks to make the loans therein provided for, each of the Guarantors is willing to guarantee, severally and not jointly, the payment when due of a percentage of the principal of and interest on the Notes as hereinafter provided and

WHEREAS, due corporate proceedings have been taken by each Guarantor and all necessary authorizations or approvals of governmental administrative agencies or other regulatory bodies have been obtained with respect to the execution on its behalf of this agreement and its unconditional several guaranty herein provided for;

The Guarantors severally covenant and agree as follows:

FIRST: Each Guarantor hereby severally agrees with the Banks and the Agent to guarantee and does hereby unconditionally guarantee, the due and punctual payment

of the percentage set opposite its name below of the principal of and interest on each and every one of the Notes and of the indebtedness represented thereby, as and when the same shall respectively become due and payable, whether at maturity or by declaration or otherwise, pursuant to the provisions of the Notes and of the Loan Agreement, and in case the Company shall fail to pay the principal of or interest on any of the

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Notes and of the indebtedness represented thereby, as and when the same shall respectively become due and payable, whether at maturity or by declaration or otherwise, pursuant to the provisions of the Notes and the Loan Agreement, each Guarantor severally covenants and agrees duly and punctually to pay, in the manner provided in Section 28 of the Loan Agreement, the percentage of the same set opposite its name below:

Name of Guarantor	*Percentages Guaranteed*
Central Hudson Gas & Electric Corporation	.80
The Cincinnati Gas & Electric Company	1.00
Columbus and Southern Ohio Electric Company	1.00
Consumers Power Company	10.00
Delaware Power & Light Company	1.00
The Detroit Edison Company	58.84
Iowa-Illinois Gas and Electric Company	.48
Long Island Lighting Company	2.48
Philadelphia Electric Company	10.00
Potomac Electric Power Company	3.20
Rochester Gas and Electric Corporation	1.80
The Southern Company	8.00
Wisconsin Electric Power Company	1.20

Each Guarantor agrees that every payment made by it on account of principal of or interest on the Notes pursuant to its guaranty herein shall constitute a contribution by it to the Company to aid it in its scientific research and development and otherwise to further the work of the Company and in no event shall be deemed an advance or loan to the Company which is subject to repayment or which creates a claim of any kind against the Company.

SECOND: Each Guarantor hereby authorizes and directs the Company, in the name and on behalf of such Guarantor, to cause to be endorsed on the back of each Note executed and delivered by it a legend in the form set forth in Annex B to the Loan Agreement.

THIRD: Each Guarantor assents to the terms, covenants and conditions of the Notes and of the Loan Agreement and irrevocably waives presentation, demand or protest of any of the Notes and any and all notice of any such presentation, demand or protest. The obligation of each Guarantor hereunder or under its guaranty of a percentage of the principal of and interest on each of the Notes shall not be affected by the recovery of any judgment against the Company or any successor corporation, or by the levy of execution under any such judgment, or by any action or proceeding taken by the Agent or by the holder or holders of any of the Notes, either under the Notes or under the Loan Agreement, for the enforcement thereof or in the exercise of any right or power given or conferred thereby, or by any delay, failure, or omission upon the part of the Agent to enforce any of the rights or powers given or conferred by the Loan Agreement or this agreement, or by any delay, failure or omission on the part of

any holder or holders of the Notes to enforce any right of such holder or holders against the Company or any successor corporation, or by any action of the Agent, or by any holder or holders of said Notes in granting indulgence to the Company or to any successor corporation or in granting any extension of time of payment, or in waiving or acquiescing in any default upon the part of the Company or any successor corporation under the Notes,

or under the Loan Agreement, or by any breach, alteration, change or enforcement of any of the terms and provisions of the Loan Agreement or otherwise in respect thereof or by any other act or delay or failure to act or by any other thing which may or might in any manner or to any extent vary the risk of any Guarantor under this agreement or under the guaranty of its percentage of the principal of and interest on said Notes, in accordance herewith; it being the purpose and intent of the parties hereto that the said several guaranties and the several obligations of the Guarantors hereunder shall be absolute and unconditional under any and all circumstances, and shall not be discharged except by payment as herein provided, and then only to the extent of such payment or payments.

FOURTH: Each Guarantor agrees that its right to payment of principal of and interest on any indebtedness that may hereafter exist from the Company to them is hereby expressly subordinated to the prior payment of the Notes and any other guaranteed indebtedness hereafter incurred by the Company as permitted by clause (b) of Section 4.3

of the Loan Agreement (the Notes and any such other guaranteed indebtedness being herein called "Guaranteed Indebtedness") as follows:

Upon any distribution of assets of the Company upon any dissolution, winding up, liquidation or reorganization of the Company, whether in bankruptcy, insolvency or receivership proceedings or upon an assignment for the benefit of creditors or any other marshalling of the assets and liabilities of the Company or otherwise,

(a) the holders of Guaranteed Indebtedness shall first be entitled to receive payment in full of the principal thereof and the interest due thereon before the Guarantors or other members of the Company (hereinafter collectively called the "members of the Company") are entitled to receive any payment upon the principal of or interest on any indebtedness from the Company to them; and

(b) any payment or distribution of assets of the Company of any kind or character, whether in cash, property or securities to which the members of the Company would be entitled except for these provisions shall be paid by the trustee or agent or other person making such payment or distribution (or by the members of the Company if received by them) direct to the holders of Guaranteed Indebtedness or their representative or representatives ratably according to the aggregate amounts remaining unpaid on account of the principal of and interest on Guaranteed Indebtedness held or represented by each, to the extent necessary to make payment in full of all Guaranteed Indebtedness remaining unpaid, after giving effect to any concurrent

payment or distribution to the holders of Guaranteed Indebtedness.

Nothing contained herein is intended to or shall impair, as between the Company, its creditors other than the holders of Guaranteed Indebtedness and the members of the Company the obligation of the Company, which is unconditional and absolute, to pay to such members the principal of and interest on any indebtedness from the Company to them as and when the same shall become due and payable in accordance with its terms, or to affect the relative rights of the members and creditors of the Company other than the holders of Guaranteed Indebtedness, nor shall anything herein prevent any member from exercising all remedies otherwise permitted by applicable law upon default in the payment of any indebtedness of the Company to it, subject to the rights, if any, under these provisions of the holders of Guaranteed Indebtedness in respect of cash, property or securities of the Company received upon the exercise of any such remedy.

FIFTH: Paragraphs First to Fourth of this agreement are made by each Guarantor for the benefit of each of the Banks, the Agent and the several holders from time to time of

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the Notes and of any other Guaranteed Indebtedness of the Company, and may be enforced directly by the holders of the Notes and such other Guaranteed Indebtedness or by any of them, from time to time, as often as occasion may arise, or by the Agent for the benefit of the holders of

the Notes. The Agent, however, shall not be under any obligation to take any action for the enforcement of this agreement or of the guaranty of any Guarantor hereunder, unless requested to take such action by a writing signed by or on behalf of the holders of not less than 25% in principal amount of the Notes then outstanding and tendered reasonable indemnity against the expenses and liabilities which it may incur in connection with or by reason of such action.

SIXTH: The Agent shall not be responsible for the recitals herein. The Agent shall not be accountable in respect of the form, validity or enforceability of this agreement, or of any of the provisions hereof, nor of the several guaranties of the Guarantors hereunder, and it makes no representation with respect thereto. All rights of action under this agreement or under the said guaranties may be enforced by the Agent without the possession of any of the Notes, or the production thereof on the trial or other proceedings relative thereto.

SEVENTH: It is an express condition of each of the several guaranties provided for in this agreement that no recourse whatsoever shall be had under said guaranty against any stockholder, officer, director or employee as such of any Guarantor, or of any successor corporation, either at law or in equity, and whether by the enforcement of any assessment or penalty or by virtue of any statute, constitution or rule of law, or otherwise. All such rights and claims are expressly waived and released as a condition of and in consideration for the execution of this agreement and of said legend endorsed on the Notes.

EIGHTH: All covenants and agreements herein contained shall bind and inure to the benefit of the successors of the parties hereto respectively, and any successor Agent duly acting as such under the terms of the Loan Agreement or any trustee acting under any indenture pursuant to which Notes have been issued shall be deemed to be a successor of the Agent under the provisions of this agreement.

NINTH: This agreement shall be deemed to be a contract made under and shall be construed in accordance with and governed by the laws of the State of New York. Neither this agreement nor any provision hereof may be changed, waived, discharged or terminated orally but only by an instrument in writing signed by the party against which enforcement of the change, waiver, discharge or termination is sought.

IN WITNESS WHEREOF the parties hereto have executed this agreement as of the day and year above set forth.

CENTRAL HUDSON GAS & ELECTRIC CORPORATION

By .....

Vice President

THE CINCINNATI GAS & ELECTRIC COMPANY

By .....

Vice President

COLUMBUS AND SOUTHERN OHIO ELECTRIC COMPANY

By .....

Vice President

CONSUMERS POWER COMPANY

By .....
Vice President

DELAWARE POWER & LIGHT COMPANY

By .....
Vice President

THE DETROIT EDISON COMPANY

By .....
Vice President

IOWA-ILLINOIS GAS AND ELECTRIC COMPANY

By .....
Vice President

LONG ISLAND LIGHTING COMPANY

By .....
Vice President

PHILADELPHIA ELECTRIC COMPANY

By .....
Vice President

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POTOMAC ELECTRIC POWER COMPANY

By .....
Vice President

ROCHESTER GAS AND ELECTRIC CORPORATION

By .....
Vice President

THE SOUTHERN COMPANY

By .....

Vice President

WISCONSIN ELECTRIC POWER COMPANY

By .....

Vice President

J. P. MORGAN & CO. INCORPORATED
As Trustee of various pension trusts

By .....

Vice President

BANKERS TRUST COMPANY
As Trustee of various pension trusts

By .....

Vice President

THE CHASE MANHATTAN BANK
As Trustee of various pension trusts

By .....

Vice President

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[5451]

THE FIRST NATIONAL CITY BANK OF NEW YORK
As Trustee of various pension trusts

By .....

Vice President

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CITY BANK FARMERS TRUST COMPANY
As Trustee of various pension trusts

By .....
Vice President

BANKERS TRUST COMPANY
As Trustee under agreement with American Brake Shoe Company dated May 17, 1940

By .....
Vice President

J. P. MORGAN & CO. INCORPORATED
As Agent

By .....
Vice President

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[5474]

Application Exhibit XXIV

(CONTRIBUTION COMMITMENT LETTERS FROM PRDC MEMBERS; ONLY ONE SAMPLE PRINTED)

ALABAMA POWER COMPANY
BIRMINGHAM 2, ALABAMA

October 23, 1956

Power Reactor Development Company
1911 First Street
Detroit 26, Michigan

Gentlemen:

As one of the companies interested in the experimental power reactor project of Power Reactor Development Com-

pany (PRDC) to determine the soundness and economy of producing electrical energy for public utility service by means of a nuclear power reactor of the type which PRDC is constructing, and in order to promote the scientific research purposes of PRDC and to aid in advancing learning and technology in the field of atomic energy, and in consideration of the pledges of others similarly interested aggregating with this commitment not less than $21,000,000:

We hereby agree to contribute to PRDC the sum of $160,000 per year for five years, commencing with the year 1956, subject to call by PRDC and payable from time to time within 30 days after each such call.

Such payments shall be cumulative, i.e. any payment not called in a given year may be added in whole or in part to the payment called in any subsequent year. Any payments already made to PRDC at the date of this commitment shall be credited against the earliest call.

This commitment shall be subject to the obtaining by us of satisfactory approval and consent of any public regulatory agencies having jurisdiction.

Yours very truly,

ALABAMA POWER COMPANY

By WALTER BASELD
Executive Vice President

[5529]

Application Exhibit XXVII

PRDC ENRICO FERMI ATOMIC POWER PLANT PROJEC
CONSTRUCTION ESTIMATE

Description	*Material*	*Labor*	*To*
Structures and Improvements			
General Fill			
Dredge and grade fill on site		$ 135,000	$ 135
Riprap	$ 12,000	17,000	29
Site Improvements			
Finish grading and gravel	9,000	6,000	15
Roads and parking area	20,000	45,000	65
Railroad track	18,000	22,000	40
Yard Piping all services	18,000	27,000	45
Storm sewers, drains and catch basins	10,000	20,000	30
Yard lighting	5,000	10,000	15
Fencing	6,000	4,000	10
Landscaping	5,000	10,000	15
Total Material and Labor	$ 103,000	$ 296,000	$ 399
Contingencies	10,300	29,600	39
Total	$ 113,300	$ 325,600	$ 438
Reactor Plant Structures			
Reactor containment vessel excavation foundations and external concrete work	$ 228,400	$ 242,600	$ 471
Containment vessel	735,250		735
Internal structural and concrete work and equipment decay tanks	841,525	511,490	1,353
Element decay and storage structure	228,585	199,865	428
Repair shop and shipping	86,365	54,795	141
Office building	125,000	150,000	275

Boiler rooms	95,000	125,000	220,000
Service building	200,000	200,000	400,000
Hot cave building	15,000	20,000	35,000
Sodium storage and inert gas building	110,000	115,000	225,000
Control room relay and switchgear rooms	35,000	45,000	80,000
Electrical equipment room	35,000	48,000	83,000
Connecting passageways between buildings	7,000	9,000	16,000

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[5530]

Description	*Material*	*Labor*	*Total*
Reactor Plant Structures (Contd)			
Stack	$ 75,000	$ 10,000	$ 85,000
Fan rooms and stack	15,000	10,000	25,000
Total Material and Labor	$ 2,832,125	$1,740,750	$ 4,572,875
Contingencies	283,275	174,050	457,325
Total	$ 3,115,400	$1,914,800	$ 5,030,200
Reactor Plant Equipment			
Primary shield tank including steel and graphite shielding gas cooling system and reactor vessel supports	$ 382,500	$ 95,000	$ 477,500
Reactor vessel including steel shielding internal structures, heating system	1,107,300	87,500	1,194,800
Rotating plug including shield disks, index system, controls, drives, Nak and gas seals	556,350	70,000	626,350
Control rods including fast neutron poison	213,800	15,000	228,800
Control rod actuators	282,100	25,000	307,100
Ionization chambers	30,000	6,000	36,000

Overhead crane with gripper 150 t, and auxiliary 25 t, remote control from operating floor	175,000	25,000	200
Offset element handling mechanism	266,900	60,000	326
Element memory system	220,000	80,000	300
Element transfer rotor and drive	125,000	35,000	160
Element transfer cask and car	400,000	10,000	410
Element transfer and cleanup	200,000	40,000	240
Underwater hydraulic opr cart	80,000	20,000	100
Decay storage racks	550,000	130,000	680
Decay building gas and water systems and disassembly machinery	290,000	70,000	360
chinery	290,000	70,000	360
Total Material and Labor	$ 4,878,950	$ 768,500	$ 5,643
Contingencies	731,750	115,500	847
Total	$ 5,610,700	$ 884,000	$ 6,493
Liquid Metal System			
Primary System Na to Na			
Sodium pumps including sump tanks and drives and heating	$ 480,000	$ 40,000	520

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Description	*Material*	*Labor*	*T*
Primary System Na to Na (Contd)			
Pump tank insulation	$ 15,000	$	$ 15
Intermediate heat exchanger	925,000	30,000	955
Heat exchanger insulation	15,000		45
Main loop piping including blanket flow and overflow piping with supports	165,000	65,000	230

6" blanket flow control valves (bellows seal)	30,000	3,000	33,000
Secondary containment and leak detection system	50,000	20,000	70,000
Pipe insulation including boron carbide covering	20,000		20,000
Overflow tank	20,000	5,000	25,000
Overflow pumps and motors	100,000	25,000	125,000
Total Material and Labor	$ 1,820,000	$ 188,000	$ 2,008,000
Contingencies	546,000	66,000	612,000
Total	$ 2,366,000	$ 254,000	$ 2,620,000
Secondary System Na to Water			
Steam generators	$ 600,000	$ 50,000	$ 650,000
Steam generator insulation	20,000		20,000
Steam generator supports	3,000	1,500	4,500
Sodium pumps and drives	390,000	15,000	405,000
Pump insulation	7,000		7,000
Pump supports	2,000	1,500	4,500
Main loop piping, supply and return including supports	102,000	30,000	132,000
Pipe heating and controls	14,000	6,000	20,000
Secondary containment and leak detection system	40,000	20,000	60,000
Pipe insulation	15,000		15,000
Total Material and Labor	$ 1,194,000	$ 124,000	$ 1,318,000
Contingencies	358,000	37,000	395,000
Total	$ 1,552,000	$ 161,000	$ 1,713,000
Liquid Metal Storage			
Storage tanks, three 15,000 gal, three 6000 gal	$ 150,000	$ 30,000	$ 180,000
Tank heating	60,000	30,000	90,000
Tank supports	8,000	5,000	13,000
Unloading and purification system including Nak cooling	200,000	50,000	250,000
Total Material and Labor	$ 418,000	$ 115,000	$ 533,000

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Description	Material	Labor	To
Contingencies	$ 125,000	$ 34,000	$ 159
Total	$ 543,000	$ 149,000	$ 692
Other Reactor Plant Equipment and Facilities			
Hot cave structure and equipment	$ 208,000	$ 56,000	$ 264
Conventional physics and chemical laboratory equipment	145,000	5,000	150
Health physics instruments and equipment	160,000	40,000	200
Health physics wiring and conduit	15,000	60,000	75
Inert gas system including vent gas system	170,000	80,000	250
Reactor plant instrumentation and control boards	700,000	150,000	850
Instrument wiring and tubing	100,000	100,000	200
Steam and feedwater piping from steam generator outlet to steam generator enclosure wall	150,000	80,000	230
Steam generator instrumentation including control air compressor, tubing etc	40,000	60,000	100
Accessory electric equipment	616,000	291,000	907
Emergency power supply equipment	150,000	15,000	165
Total Material and Labor	$ 2,454,000	$ 937,000	$ 3,391
Contingencies	736,000	281,000	1,017
Total	$ 3,190,000	$1,218,000	$ 4,408

Initial Operating Supplies			
Neutron source	$ 18,000	$ 2,000	$ 20,000
Initial core elements	233,000	23,000	256,000
Initial blanket elements	377,000	143,000	520,000
Initial sodium, inert gas, NaK etc	250,000	15,000	265,000
Total Material and Labor	$ 878,000	$ 183,000	$ 1,061,000
Contingencies	263,000	54,000	317,000
Total	$ 1,141,000	$ 237,000	$ 1,378,000

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Description	*Material*	*Labor*	*Total*
Miscellaneous Reactor Plant Equipment and Facilities			
Office furniture and equipment	$ 18,000	$ 2,000	$ 20,000
Transportation equipment	5,000		5,000
First aid equipment	2,000		2,000
Maintenance tools and equipment	80,000	20,000	100,000
Waste disposal equipment	24,000	6,000	30,000
Shipping casks	120,000	6,000	126,000
Miscellaneous systems and power plant equipment	195,000	35,000	230,000
Cold element assembly equipment	80,000	11,000	91,000
Total Material and Labor	$ 524,000	$ 80,000	$ 604,000
Contingencies	78,000	12,000	90,000
Total	$ 602,000	$ 92,000	$ 694,000
Total Material and Labor	$18,233,400	$5,235,400	$23,468,800
Construction plant, equipment rental, tools and fee			$ 2,977,000

Spare parts, control rods, rod actuators, core and blanket elements	16
Preoperation testing after construction	3
Personnel training	5
Initial operation low to full load	3
Interest during construction	1,8
Engineering services and expenses	9
Local taxes etc	5
Working capital	1,1
TOTAL ESTIMATED PLANT COST	$32,4

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[5534]

PRDC ENRICO FERMI ATOMIC POWER PLANT PROJECT
TOTAL ESTIMATED PLANT COST BY YEARS

(Figures are in Thousands of Dollars)

	1956	1957	1958	1959	1960	Total
Site Improvements	$335.0	$ 65.0			$ 38.9	$ 438.9
Structures	400.0	2,300.0	$1,500.0	$ 630.2	200.0	5,030.2
Equipment, Reactor Plant		1,590.0	1,410.0	3,216.7	278.0	6,494.7
Liquid Metal System		500.0	2,000.0	2,525.0		5,025.0
Other Reactor Plant Equipment		200.0	2,000.0	2,208.0		4,408.0
Initial Supplies		300.0	1,000.0	78.0		1,378.0
Miscellaneous		50.0	200.0	300.0	144.0	694.0
Subtotal	$735.0	$5,005.0	$8,110.0	$ 8,957.9	$ 660.9	$23,468.8
Construction Plant	75.0	550.0	775.0	1,202.0	375.0	2,977.0
Spare Parts				160.0		160.0
Preoperating Tests				300.0	50.0	350.0
Personnel Training				350.0	150.0	500.0
Initial Low Load Operation				100.0	450.0	550.0
Interest		150.0	450.0	600.0	600.0	1,800.0
Local Taxes		8.9	65.0	150.0	295.3	519.2
Engineering	75.0	250.0	350.0	200.0	25.0	900.0
Subtotal	$885.0	$5,963.9	$9,750.0	$12,019.9	$2,606.2	$31,225.0
Working Capital						1,175.0
						$32,400.0

Total Estimated Plant Cost by Years Excluding Working Capital of $1,175.0 and Allowance of $3,000.0 for Equipment and Devices to be Furnished by Atomic Power Development Associates

	1956	*1957*	*1958*	*1959*	*1960*	*Total*
Subtotal	$885.0	$5,063.9	$7,650.0	$12,019.9	$2,606.2	$28,225.0

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PRDC ENRICO FERMI ATOMIC POWER PLANT PROJECT

Estimated Construction Administrative and Research and Development Costs During Construction, and Pre-Operational Testing Period (1956-1960)

(Figures are in Thousands of Dollars)

Estimated Plant Cost (Excluding Working Capital and Allowance for equipment and devices to be furnished by Atomic Power Development Associates)		$28,225.0
Estimated Cost Savings to PRDC of equipment and devices to be furnished by Atomic Power Development Associates.		3,000.0
Working Capital		1,175.0
Administrative Expenses during Construction and Pre-Operational Testing (1956-1960)		1,816.0
Research and Development Costs during Construction and Pre-Operational Testing (1956-1960)		
To be paid for by PRDC	$5,000.0	
To be furnished in kind by APDA	4,000.0	9,000.0
Total Overall Costs		$43,216.0

[5536]

Application Exhibit XXVIII

(SEE ALSO LATER EXHIBIT, APPLICATION EXHIBIT XLIII, TR. PP. 6065-69)

POWER REACTOR DEVELOPMENT COMPANY
ENRICO FERMI ATOMIC POWER PLANT PROJECT

STATEMENT OF SOURCE AND APPLICATION OF CASH DURING CONSTRUCTION PERIOD

Arthur Andersen & Co.
Detroit

December 31, 1956

[5537]

POWER REACTOR DEVELOPMENT COMPANY
ENRICO FERMI ATOMIC POWER PLANT PROJECT

STATEMENT OF SOURCE AND APPLICATION OF CASH DURING CONSTRUCTION PERIOD

At the request of the Company, the attached statements have been prepared showing the source and application of cash during the construction period which period includes the years 1956 through the years of pre-operational testing, 1960. Power Reactor Development Company has received an opinion from its tax counsel, Mr. Roswell Magill, that it is exempt from Federal income taxation as a non-profit scientific institution under Section 501 of the Internal Revenue Code of 1954. A request for ruling that it is such a tax-exempt organization is now pending before the Internal Revenue Service. Schedule 1 is a statement of source and

application of cash during the construction period based on the assumption that the company will not be subject to Federal income tax liability during this period.

In addition, a statement of source and application of cash has been prepared on the assumption that, contrary to the opinion of its tax counsel, favorable action will not be received on its pending request for ruling. Schedule 2, showing source and application of cash during the construction period, is based on the assumption that there will be Federal income tax liability.

[5538]

Cash sources are based upon the commitment contracts in existence between the Company and its members, and upon the Loan Agreement between the Company and J. P. Morgan & Co., Incorporated, as agent for certain banks.

Cash applications are based upon data furnished by Commonwealth Associates, Inc., architects and engineers for the project, and by Company personnel. Commonwealth Associates, Inc., furnished the estimated annual plant costs. Company personnel furnished the estimated remaining annual cash applications such as direct research and development cost, administrative expense, interest expense, and local taxes.

In determining the Federal income tax liability shown on Schedule 2, contributions by the members are treated as taxable income to the Company. Tax deductible expenses are cash expenditures other than those capitalized as plant cost. In accordance with an opinion of tax counse for the

Company, cost of the plant (exclusive of the estimated site improvement costs) in excess of the cost of conventional facilities is considered as research and development expense. Cost of a conventional steam plant of the same capacity is estimated by Company engineers to be approximately $13,200,000.

SCHEDULE NO. 1

STATEMENT OF SOURCE AND APPLICATION OF CASH

DURING CONSTRUCTION PERIOD

ASSUMING THAT COMPANY HAS NO FEDERAL INCOME TAX LIABILITY

Particulars	Line No.	Year 1956	1957	1958	1959	1960 (test year)	Total
Source of cash-							
Contributions (see Note 1)	1	$2,051,400	$ -	$ 2,572,500	$13,369,900	$5,546,200	$23,540,000
Long-term bank loans	2	-	8,000,000	7,000,000	-	-	15,000,000
Total source of cash	3	$2,051,400	$8,000,000	$ 9,572,500	$13,369,900	$5,546,200	$38,540,000
Application of cash-							
Plant expenditures (see Schedule No. 4) Line 5	4	$1,135,000	$5,205,000	$ 7,435,000	$11,619,900	$2,326,900	$27,721,800
Interest	5	-	150,000	450,000	600,000	600,000	1,800,000
Property taxes	6	-	8,900	65,000	150,000	295,300	519,200
Direct research and development cost	7	-	1,500,000	2,500,000	1,000,000	-	5,000,000
Total application of cash (see Note 2)	8	$1,135,000	$6,863,900	$10,450,000	$13,369,900	$3,222,200	$35,041,000
Net cash increase (decrease) during year	9	$ 916,400	$1,136,100	$ (877,500)	$ -	$2,324,000	$ 3,499,000
Cash balance - end of year	10	$ 916,400	$2,052,500	$ 1,175,000	$ 1,175,000	$3,499,000	

NOTES:

(1) A contribution in kind to the extent of $1,000,000 is reflected in the contributions to be received in 1958 as the goods and services to be contributed will be required in that year under the construction schedule.

(2) Total estimated project consists of-

Total application of cash by PRDC (see Line No. 8)	$35,041,000
Working capital	1,175,000
Total PRDC cash requirement	$36,216,000
Value to PRDC of research, development, test devices and equipment to be provided by Atomic Power Development Associates	7,000,000
Total estimated project	$43,216,000

EXHIBIT XXVIII

SCHEDULE NO. 2

STATEMENT OF SOURCE AND APPLICATION OF CASH

DURING CONSTRUCTION PERIOD

ASSUMING THAT COMPANY HAS FEDERAL INCOME TAX LIABILITY

Particulars	Line No.	Year 1956	1957	1958	1959	1960 (test year)	Total
Source of cash-							
Contributions (see Note)	1	$2,051,400	$ -	$2,572,500	$13,369,900	$5,546,200	$23,540,000
Long-term bank loans	2	-	8,000,000	7,000,000	-	-	15,000,000
	3	$2,051,400	$8,000,000	$9,572,500	$13,369,900	$5,546,200	$38,540,000
Application of cash-							
Plant expenditures (see Schedule No. 4)	4	$1,135,000	$5,205,000	$7,435,000	$11,619,900	$2,326,900	$27,721,800
Interest	5	-	150,000	450,000	600,000	600,000	1,800,000
Property taxes	6	-	8,900	65,000	150,000	295,300	519,200
Direct research and development cost	7	-	1,500,000	2,500,000	1,000,000	-	5,000,000
Federal income tax payments (refunds) (see Schedule No. 3) line 9	8	149,300	697,200	(846,500)	-	503,100	503,100
	9	$1,284,300	$7,561,100	$9,603,500	$13,369,900	$3,725,300	$35,544,100
Net cash increase (decrease) during year	10	$ 767,100	$ 438,900	$ (31,000)	$ -	$1,820,900	$ 2,995,900
Cash balance - end of year	11	$ 767,100	$1,206,000	$1,175,000	$ 1,175,000	$2,995,900	

NOTE: A contribution in kind to the extent of $1,000,000 is reflected in the contributions to be received in 1958 as the goods and services to be contributed will be required in that year under the construction schedule.

EXHIBIT XXVIII

SCHEDULE NO. 1

CALCULATION OF FEDERAL INCOME TAX PAYMENTS DURING CONSTRUCTION PERIOD

Particulars	Line No.	Year 1956	1957	1958	1959	1960 (test year)	Total
Contributions	1	$2,051,400	$ -	$ 2,572,500	$13,369,900	$5,546,200	$23,540,000
Expenses deductible for tax purposes-							
Direct research and development cost	2	$ -	$ 1,500,000	$ 2,500,000	$ 1,000,000	$ -	$ 5,000,000
Portion of plant expenditures considered to be research and development cost (see Schedule No. 4) Line 2	3	412,900	2,653,200	3,837,800	5,998,000	1,181,000	14,082,900
Interest payments	4	-	150,000	450,000	600,000	600,000	1,800,000
Property taxes	5	-	8,900	65,000	150,000	295,300	519,200
Total	6	$ 412,900	$ 4,312,100	$ 6,852,800	$ 7,748,000	$2,076,300	$21,402,100
Net taxable income (loss)	7	$1,638,500	$(4,312,100)	$(4,280,300)	$ 5,621,900	$3,469,900	$ 2,137,900
Federal income tax liability	8	$ 846,500	$ -	$ -	$ -	$1,106,200	
Federal income tax payments (refunds)	9	$ 149,300	$ 697,200	$ (846,500)	$ -	$ 503,100	$ 503,100

EXHIBIT XXVIII

SCHEDULE NO. 4

CALCULATION OF PLANT EXPENDITURES AND PORTION CONSIDERED RESEARCH AND DEVELOPMENT COST

BASED ON ESTIMATED EXPENDITURES

Particulars	Line No.	Year 1956	1957	1958	1959	1960 (test year)	Total
Total estimated plant cost per Commonwealth Associates, Inc.	1	$ 885,000	$5,063,900	$7,650,000	$12,019,900	$2,606,200	$28,225,000
Adjustments-							
Deduct- Interest during construction included in estimated plant cost	2	-	(150,000)	(450,000)	(600,000)	(600,000)	(1,800,000)
Deduct- Property taxes included in estimated plant cost	3	-	(8,900)	(65,000)	(150,000)	(295,300)	(519,200)
Add- Administration expenses	4	250,000	300,000	300,000	350,000	616,000	1,816,000
Plant expenditures	5	$1,135,000	$5,205,000	$7,435,000	$11,619,900	$2,326,900	$27,721,800
Deduct- Site improvements	6	(335,000)	(65,000)	-	-	(38,900)	(438,900)
Deduct- Estimated cost of conventional steam plant	7	(387,100)	(2,486,800)	(3,597,200)	(5,621,900)	(1,107,000)	(13,200,000)
Portion of plant expenditures considered research and development cost	8	$ 412,900	$2,653,200	$ 3,837,800	$ 5,998,000	$1,181,000	$14,082,900

APPLICATION EXHIBIT VII-B

SPECIAL NUCLEAR MATERIALS - REQUIRED AND PRODUCED
Weekly Subassembly Removal Program

	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
Reactor Power, mw	- -	- -	333	300	300	350	350	400	430	430	430	430	430	430	430	430	430
Plant Factor, %	- -	- -	35	40	45	70	70	75	75	70	80	80	80	80	80	80	80
Fuel Burn-up, % Total Atoms of Alloy	- -	- -	1.0	1.0	1.5	2.0	2.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Special Nuclear Materials																	
Fuel Alloy *																	
(a) - Required from AEC (Kg)	2,493.9	- -	1,616.4	3,589.0	3,287.6	4,986.3	4,109.6	3,990.4	4,657.5	3,369.8	4,109.6	4,931.4	4,219.2	4,109.6	4,712.3	4,639.3	4,657.5
(b) - Returned to AEC as Scrap (Kg)	498.4	- -	323.0	717.2	657.0	996.5	821.3	777.5	930.9	673.4	821.3	985.5	843.2	821.3	941.7	927.0	930.9
(c) - Fabrication Losses (Kg)	2.0	- -	1.3	2.9	2.6	4.0	3.3	3.1	3.7	2.7	3.3	3.9	3.4	3.3	3.8	3.5	3.7
(d) - Required for Reactor Cycling (a)-(b)-(c)																	
1. Subassemblies	91	- -	59	131	120	182	150	142	170	123	150	180	154	150	172	162	170
2. Uranium (Kg)	1,992.9	- -	1,292.1	2,868.9	2,628.0	3,985.9	3,285.0	3,109.8	3,723.0	2,693.7	3,285.0	3,942.0	3,372.6	3,285.0	3,766.9	3,587.9	3,723.0
(e) - Returned to AEC after irradiation																	
1. Subassemblies	- -	- -	- -	101	142	140	168	142	151	142	150	162	162	150	150	172	151
2. Uranium (Kg)	- -	- -	- -	2,175.8	3,045.7	2,976.2	3,567.0	2,992.3	3,144.9	2,959.3	3,128.5	3,375.6	3,374.8	3,125.0	3,125.6	3,593.3	3,145.6
(f) - Difference: (a)-(b)-(c)-(e) (Kg)	1,992.9	- -	1,292.1	693.1	(117.7)	1,809.6	(282.0)	117.5	579.1	(265.6)	156.5	566.4	(2.2)	166.0	641.2	(35.5)	577.4
(g) - Year End Inventory																	
1. In Reactor (Kg)	- -	1,992.9	1,992.9	1,992.9	1,992.9	1,992.9	1,992.9	1,992.9	1,992.9	1,992.9	1,992.9	1,992.9	1,992.9	1,992.9	1,992.9	1,992.9	1,992.9
2. In Decay Storage (Kg)	- -	- -	- -	1,467.3	1,248.3	1,730.1	1,992.9	1,576.9	1,554.9	1,554.9	1,992.9	1,554.9	1,467.3	1,817.7	2,036.7	1,730.1	1,379.7
3. In Fabrication (Kg)	1,992.9	- -	1,292.1	481.8	219.0	657.0	- -	416.1	454.1	438.0	- -	932.2	744.6	394.2	657.0	744.6	1,511.1
4. Total (Kg)	1,992.9	1,992.9	3,285.0	3,942.0	3,460.2	4,380.0	3,985.8	3,985.8	4,401.9	3,985.8	3,985.8	4,380.0	4,204.8	4,204.8	4,686.6	4,467.6	4,883.7
(h) - Plutonium from Irradiated Sub-assemblies (Kg)	- -	- -	- -	8.85	15.75	21.98	27.45	28.87	39.26	36.82	36.66	42.03	42.18	39.04	38.86	44.70	39.14
(i) - U-235 Consumed (Kg)	- -	- -	- -	27.29	48.36	67.78	96.76	88.67	122.71	113.72	119.98	130.22	130.85	120.98	120.50	138.76	122.13
Total Blanket																	
(a) - Required from AEC (Kg)	51,666.0	- -	3,813.4	13,030.3	19,663.4	30,717.8	58,442.3	32,162.0	34,547.4	35,749.0	38,099.9	70,095.3	34,346.8	34,562.0	43,107.5	38,101.9	66,211.0
(b) - Returned to AEC as Scrap (Kg)	10,292.1	- -	762.1	2,604.0	3,729.7	6,138.7	11,679.2	6,427.3	6,904.0	7,144.1	7,613.9	14,007.9	6,863.9	6,906.9	8,614.6	7,626.3	13,231.7
(c) - Fabrication Losses (Kg)	51.0	- -	3.0	10.4	14.9	24.5	46.7	25.7	27.6	28.6	30.5	56.0	27.5	27.7	34.5	30.5	52.9
(d) - Required for Reactor Cycling (a)-(b)-(c)																	
1. Subassemblies	637	- -	79	227	284	458	752	450	491	479	522	902	482	482	592	530	852
2. Uranium (Kg)	41,122.9	- -	3,048.3	10,415.9	14,919.8	24,554.6	46,716.4	25,709.0	27,615.9	28,576.3	30,455.4	56,031.4	27,455.4	27,627.4	34,458.4	30,505.0	52,926.4
(e) - Returned to AEC after Irradiation																	
1. Subassemblies	- -	- -	- -	121	262	344	400	900	479	450	490	558	868	450	550	588	431
2. Uranium (Kg)	- -	- -	- -	4,205.7	12,398.9	19,252.1	20,995.4	50,334.9	27,249.2	25,630.4	28,106.5	32,370.0	54,241.7	25,291.7	32,330.1	34,058.4	23,908.5
(f) - Difference: (a)-(b)-(c)-(e) (Kg)	41,122.9	- -	3,048.3	8,210.2	2,530.0	6,302.5	25,721.0	(24,625.9)	326.6	2,945.9	2,348.9	23,661.4	(26,736.3)	2,335.7	2,128.3	(3,553.4)	29,017.9
(g) - Year End Inventory																	
1. In Reactor (Kg)	- -	41,122.9	41,122.9	41,122.9	41,122.9	41,122.9	41,122.9	41,122.9	41,122.9	41,122.9	41,122.9	41,122.9	41,122.9	41,122.9	41,122.9	41,122.9	41,122.9
2. In Decay Storage (Kg)	- -	- -	- -	4,966.7	6,103.7	10,955.1	32,446.5	13,872.0	14,975.5	16,106.7	15,912.3	36,892.5	10,057.1	17,287.5	16,998.9	12,086.3	41,761.3
3. In Fabrication (Kg)	41,122.9	- -	3,048.3	4,285.9	5,650.2	7,052.6	6,221.6	5,051.1	4,191.1	5,927.2	8,484.0	10,950.6	10,839.9	5,871.8	9,183.9	9,425.8	8,698.5
4. Total (Kg)	41,122.9	41,122.9	44,171.2	50,375.4	52,876.8	59,130.6	80,791.0	60,046.0	60,289.3	63,156.8	65,519.2	88,966.0	62,019.8	64,282.2	66,305.6	62,635.0	91,582.7
(h) - Plutonium from Irradiated Sub-assemblies (Kg)	- -	- -	- -	6.01	28.68	48.76	60.65	119.13	93.11	78.62	96.16	111.55	159.97	73.36	104.95	117.24	70.24

* 10% Mo - 90% U (27% Enriched in U-235)

1975	1976	1977	1978	197x	19x9	19xx
430	430	430	430	430	430	- -
80	80	80	80	80	80	- -
3.0	3.0	3.0	3.0	3.0	3.0	- -
4,164.3	4,138.3	4,328.9	4,219.2	4,657.5	3,389.8	- -
832.2	887.0	865.1	843.2	930.8	673.4	- -
3.3	3.5	3.5	3.4	3.7	2.7	- -
152	162	158	154	170	123	- -
3,328.8	3,547.8	3,460.2	3,372.6	3,723.0	2,693.7	- -
142	160	150	184	180	142	91
2,958.8	3,375.6	3,125.1	3,937.5	3,749.5	2,959.1	1,895.9
370.0	172.2	335.1	(464.9)	(26.5)	(265.4)	(1,895.9)
1,992.9	1,992.9	1,992.9	1,992.9	1,992.9	1,992.9	- -
1,730.1	1,730.1	1,992.9	1,969.1	1,379.1	1,992.9	- -
1,379.7	1,379.7	1,292.1	678.9	1,029.3	- -	- -
5,102.7	5,102.7	5,277.9	4,620.9	4,401.3	3,985.8	- -
38.92	41.97	38.99	46.81	46.91	36.86	23.60
114.05	130.19	120.89	145.28	145.60	113.85	73.37
36,400.1	38,515.6	40,499.7	38,592.2	59,489.1	30,796.0	- -
7,274.2	7,697.0	8,093.5	7,712.3	11,888.4	6,154.3	- -
29.1	30.8	32.4	30.9	47.5	24.6	- -
504	534	554	530	776	423	- -
29,096.8	30,787.8	32,373.8	30,849.0	47,553.2	24,617.1	- -
848	490	638	484	560	820	275
53,696.5	27,593.2	38,532.8	26,221.2	31,747.5	51,708.2	15,482.7
(24,589.7)	3,194.6	(6,159.0)	4,627.8	15,805.7	(27,091.1)	(15,482.7)
41,122.9	41,122.9	41,122.9	41,122.9	41,122.9	41,122.9	- -
15,197.1	21,701.5	12,418.7	17,453.7	30,388.1	15,529.5	- -
10,511.3	7,118.3	10,118.3	9,625.5	6,392.3	- -	- -
66,831.3	69,942.7	63,659.9	68,202.1	83,903.3	56,652.4	- -
161.12	83.87	123.71	85.62	104.53	159.83	46.75

Weekly Subassembly Removal Program (Cont.)

	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
Axial Blanket																	
(a) - Required from AEC (Kg)	3,154.0	- -	2,044.5	4,539.5	4,158.3	6,306.8	5,197.9	4,920.7	5,991.0	4,262.3	5,198.0	6,237.5	5,336.6	5,198.0	5,960.3	5,613.8	5,991.0
(b) - Returned to AEC as Scrap (Kg)	630.2	- -	408.6	907.2	831.0	1,260.4	1,038.8	983.4	1,177.3	851.8	1,038.8	1,246.5	1,066.5	1,038.8	1,191.1	1,121.9	1,177.3
(c) - Fabrication Losses (Kg)	3.1	- -	1.6	3.6	3.3	5.0	4.1	3.9	4.7	3.4	4.2	5.0	4.3	4.2	4.8	4.5	4.7
(d) - Required for Reactor Cycling (a)-(b)-(c)																	
1. Subassemblies	91	- -	59	131	120	182	150	142	170	123	150	180	154	150	172	162	170
2. Uranium (Kg)	2,520.7	- -	1,634.3	3,628.7	3,324.0	5,041.4	4,155.0	3,933.4	4,709.0	3,407.1	4,155.0	4,986.0	4,265.9	4,155.0	4,768.4	4,487.4	4,709.0
(e) - Returned to AEC after Irradiation																	
1. Subassemblies	- -	- -	- -	101	142	140	168	142	151	142	150	162	162	150	150	172	151
2. Uranium (Kg)	- -	- -	- -	2,794.6	3,927.9	3,870.3	4,644.0	3,923.3	4,168.9	3,920.5	4,141.4	4,472.6	4,472.6	4,141.3	4,141.4	4,749.6	4,169.0
(f) - Differences: (a)-(b)-(c)-(e) (Kg)	2,520.7	- -	1,634.3	834.1	(603.9)	1,171.1	(489.0)	10.1	540.1	(513.4)	13.6	513.4	(206.8)	13.7	627.0	(262.2)	540.0
(g) - Year End Inventory																	
1. In Reactor (Kg)	- -	2,520.7	2,520.7	2,520.7	2,520.7	2,520.7	2,520.7	2,520.7	2,520.7	2,520.7	2,520.7	2,520.7	2,520.7	2,520.7	2,520.7	2,520.7	2,520.7
2. In Decay Storage (Kg)	- -	- -	- -	1,955.9	1,578.9	2,188.3	2,520.7	1,994.4	1,966.7	1,966.7	2,520.7	1,966.7	1,855.9	2,299.1	2,576.1	2,188.3	1,745.1
3. In Fabrication (Kg)	2,520.7	- -	1,634.3	609.4	277.0	831.0	- -	526.3	1,080.3	554.0	- -	1,052.6	961.8	498.6	831.0	961.8	1,911.3
4. Total (Kg)	2,520.7	2,520.7	4,155.0	4,986.0	4,376.6	5,560.0	5,041.4	5,041.4	5,567.7	5,041.4	5,041.4	5,560.0	5,318.4	5,318.4	5,927.8	5,650.8	6,177.1
(h) - Plutonium from Irradiated Subassemblies (Kg)	- -	- -	- -	3.11	5.53	7.72	9.65	10.14	13.79	12.93	13.59	14.77	14.82	13.72	13.65	14.79	13.75
Radial Blanket																	
(a) - Required from AEC (Kg)	48,312.0	- -	1,768.9	8,490.8	14,505.1	24,411.0	53,244.4	27,241.3	28,656.8	31,486.7	32,901.8	63,857.8	29,010.2	29,364.0	37,147.2	32,548.0	60,320.0
(b) - Returned to AEC as Scrap (Kg)	9,661.9	- -	353.5	1,696.8	2,898.7	4,878.3	10,640.4	5,443.9	5,726.7	6,292.3	6,575.1	12,761.4	5,797.4	5,868.1	7,423.5	6,504.4	12,054.4
(c) - Fabrication Losses (Kg)	47.9	- -	1.4	6.8	11.6	19.5	42.6	21.8	22.9	25.2	26.3	51.0	23.2	23.5	29.7	26.0	43.2
(d) - Required for Reactor Cycling (a)-(b)-(c)																	
1. Subassemblies	516	- -	20	96	164	276	602	308	324	356	372	722	328	332	420	368	682
2. Uranium (Kg)	38,602.2	- -	1,414.0	6,787.2	11,594.8	19,513.2	42,561.4	21,775.6	22,906.8	25,169.2	26,300.4	51,045.4	23,189.6	23,472.4	29,694.0	26,017.6	48,217.4
(e) - Returned to AEC after Irradiation																	
1. Subassemblies	- -	- -	- -	20	120	204	232	658	328	308	340	396	706	300	400	416	280
2. Uranium (Kg)	- -	- -	- -	1,411.1	8,460.9	14,381.8	16,351.4	40,411.6	23,120.3	21,709.9	23,965.1	27,897.4	49,769.1	21,150.4	28,188.7	29,309.8	19,739.5
(f) - Differences: (a)-(b)-(c)-(e) (Kg)	38,602.2	- -	1,414.0	5,376.1	3,133.9	5,131.8	26,210.0	(24,636.0)	(213.5)	3,459.3	2,335.3	23,148.0	(26,579.5)	2,322.0	1,505.3	(3,291.2)	28,477.9
(g) - Year End Inventory																	
1. In Reactor (Kg)	- -	38,602.2	38,602.2	38,602.2	38,602.2	38,602.2	38,602.2	38,602.2	38,602.2	38,602.2	38,602.2	38,602.2	38,602.2	38,602.2	38,602.2	38,602.2	38,602.2
2. In Decay Storage (Kg)	- -	- -	- -	3,110.8	4,524.8	8,766.8	34,925.8	11,877.6	13,008.8	16,140.0	13,291.6	34,925.8	8,201.2	11,988.4	11,422.8	9,899.0	40,016.2
3. In Fabrication (Kg)	38,602.2	- -	1,414.0	3,676.4	5,373.2	6,221.6	6,221.6	4,524.8	3,110.8	5,373.2	8,484.0	9,898.0	9,898.0	5,373.2	7,352.9	8,484.0	6,787.2
4. Total (Kg)	38,602.2	38,602.2	40,016.2	45,389.4	48,500.2	53,590.6	79,749.6	55,004.6	54,721.8	58,115.4	60,377.8	83,426.0	56,701.4	58,963.8	60,377.8	56,984.2	95,405.6
(h) - Plutonium from Irradiated Subassemblies (Kg)	- -	- -	- -	2.90	23.15	41.04	51.00	108.99	69.32	65.69	72.87	99.78	145.15	59.64	91.30	102.45	56.49
Plutonium																	
Contained in Irradiated Core and Blanket Elements Returned to AEC (Kg)	- -	- -	- -	14.86	44.43	70.74	88.10	148.00	122.37	115.44	123.12	156.58	202.15	112.60	143.81	141.94	109.38
Boron-10																	
Required From AEC (Kg)	35	0	0	1.5	2.1	2.7	2.4	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3

RSC-EE/ep
12/7/56

Exhibit VII-B
Sheet 2

1975	1976	1977	1978	1979	1980	1981
5,267.2	5,613.8	5,475.2	5,336.6	5,891.0	4,268.3	- -
1,054.6	1,121.9	1,094.2	1,066.5	1,177.3	851.8	- -
4.2	4.5	4.4	4.3	4.7	3.4	- -
152	162	158	154	170	123	- -
4,210.4	4,487.4	4,376.6	4,265.8	4,709.0	3,407.1	- -
142	162	150	184	180	142	91
3,920.4	4,472.7	4,141.3	5,080.4	4,969.5	3,920.5	2,512.4
290.0	14.7	235.3	(814.6)	(260.5)	(513.4)	(2,512.4)
2,520.7	2,520.7	2,520.7	2,520.7	2,520.7	2,520.7	- -
2,188.3	2,188.3	2,520.7	2,465.3	1,745.1	2,520.7	- -
1,745.1	1,745.1	1,634.3	858.7	1,301.9	- -	- -
6,454.1	6,454.1	6,675.1	5,844.7	5,567.7	5,041.4	- -
12.97	14.75	13.70	16.45	16.48	12.95	8.29
31,132.9	32,901.8	35,024.5	33,255.6	53,598.1	26,533.7	- -
6,221.6	6,575.1	6,999.3	6,645.8	10,711.1	5,302.5	- -
24.9	26.3	28.0	26.6	42.8	21.2	- -
352	372	396	376	606	300	- -
24,986.4	26,300.4	27,997.2	26,583.2	42,844.2	21,210.0	- -
706	328	488	300	380	678	184
49,766.1	23,120.5	34,391.5	21,140.8	26,778.0	47,787.7	12,970.3
(24,879.7)	3,179.9	(6,394.3)	5,442.4	16,066.2	(26,577.7)	(12,970.3)
38,602.2	38,602.2	38,602.2	38,602.2	38,602.2	38,602.2	- -
13,008.8	19,513.2	6,998.0	14,988.4	34,643.0	13,008.8	- -
8,766.2	5,373.2	8,434.0	8,766.8	5,090.4	- -	- -
60,377.2	63,488.6	56,984.2	62,357.4	78,335.6	51,611.0	- -
148.15	69.12	110.31	69.17	88.05	146.88	38.46
198.34	125.84	162.70	122.43	151.44	196.69	70.35
3.3	3.3	3.3	3.3	3.3	3.3	3.3

[5921]

Application Exhibit XXXVI

(CONTRIBUTION COMMITMENT LETTER FROM PRDC MEMBERS FOR YEAR 1961; ONLY ONE SAMPLE PRINTED)

CENTRAL HUDSON GAS & ELECTRIC CORPORATION
POUGHKEEPSIE, N. Y.

ERNEST R. ACKER
President

July 1, 1957

Power Reactor Development Company
1911 First Street
Detroit 26, Michigan

Gentlemen:

As one of the companies interested in the experimental power reactor project of Power Reactor Development Company (PRDC) to determine the soundness of economy of producing electric energy for public utility service by means of a nuclear power reactor of the type PRDC is constructing, and in order to promote the scientific research purposes of PRDC, and to aid in advancing learning and technology in the field of atomic energy and in consideration of the pledges of others similarly interested, we hereby agree to contribute to PRDC the sum of $40,000 in the year 1961, subject to call by PRDC at any time during that year and payable within thirty (30) days after such call.

Yours very truly,

ERNEST R. ACKER

ERA/jm

[6046].

Application Exhibit XXXIX

(INTERNAL REVENUE SERVICE TAX RULING LETTER)

U. S. TREASURY DEPARTMENT
WASHINGTON 25

Jul 19 1957

Office of
Commissioner of Internal Revenue

Address Reply to
Commissioner of Internal Revenue
Washington 25, D. C.
and Refer to
T:R:C
WMD

Power Reactor Development Company
1100 Dime Bldg.
Detroit 26, Michigan

Attention: Walker L. Cisler, President

Gentlemen:

This is in reply to your letter dated December 28, 1955, with enclosures, and subsequent correspondence, in which you requested rulings as follows:

(1) That your company PRDC is exempt from Federal income tax under section 501(c)(6) of the Internal Revenue Code of 1954,

(2) That income received by PRDC from the sale of steam made by the experimental reactor and the sale of the by-product plutonium will be exempt from income taxes, and

(3) That dues and contributions paid or incurred to PRDC in cash or kind by its Members will constitute ordinary and necessary expenses, deductible by such Members in computing their respective taxable incomes under section 162 of the Code.

In letters dated February 7, 1957, and April 24, 1957, you requested that rulings with respect to your requests (1) and (2) above be held in abeyance, pending the issuance of rulings as follows:

(3) (As amended) That amounts paid or incurred in cash or kind to PRDC by a Member, i.e., Central Hudson Gas and Electric Corporation, constitute research and experimental expenses deductible by such Member under section 174(a) of the Code, and

(4) That Membership payments received by PRDC do not constitute gross income to PRDC.

[6047]

A ruling with respect to request (3) as amended, above, will be made the subject of a separate letter addressed to Central Hudson Gas and Electric Corporation, Poughkeepsie, New York.

You state PRDC was organized on August 30, 1955, as a Michigan non-profit Membership corporation to function as a business league in studying, developing, designing, constructing and operating experimental nuclear power reactors for the demonstration of the practicality of the use of nuclear energy for the generation of electric energy in response to the announcement of the United States Atomic Energy Commission (A. E. C.) of a Power Demon-

stration Reactor Program to bring private resources into the development of engineering information on the performance of nuclear power reactors and to advance the time in which nuclear power will become economically competitive.

According to your Articles of Incorporation, you will operate as a business league of members of industries to engage in all activities necessary to acquire knowledge and the ability to successfully demonstrate and disseminate such information to your Members and others regarding the use of nuclear energy, other by-products and applications thereof; to contract with others to engage in experiments, research, fabrication and construction and other work to advance such purposes; and to receive membership fees, dues, contributions and payments in cash or services from members and others. No part of your net earnings shall inure to benefit of any Member or private individual or corporation upon dissolution or other termination of your existence and any property remaining shall be distributed to a corporation organized and operated exclusively for educational or scientific purposes and not for profits to do further research and development of the use of atomic energy for peaceful purposes. At no time shall any of your property be returned to the original incorporators or other Members, or to any donors or contributors.

According to your By-Laws, as submitted under date of July 3, 1956, Members shall be your incorporators and such other legal or natural persons as shall be admitted by action of the Board of Trustees or of the Members; any individual, corporation or partnership engaged in a business or profession interested in your objectives shall be

eligible for membership, subject to clearance by the A.E.C.; all Members shall be voting Members and each Member shall be entitled to one vote on any proposition presented; except as the Board of Trustees may otherwise provide, resignation or termination of membership shall not release any financial commitment for additional funds (in addition to annual dues) for which the Member may voluntarily contract with you in writing. Your business, property and affairs shall be managed and controlled by a Board of Trustees. The Trustees shall be natural persons elected by the Members, provided that not more than one Trustee may be selected from any Member. A person otherwise eligible for election as a Trustee need not be Member. Among other duties the Board of Trustees shall adopt an annual budget. Financially, you shall receive annual dues

[6048]

from Members, not to exceed $5,000 per calendar year from each, additional funds pursuant to commitments made by each Member, contributions, gifts, donations, grants and other receipts, including loans, as the Board of Trustees may determine. Any net balance of annual dues and additional funds provided for budgeted expenses and other receipts remaining unexpended at the end of any fiscal year shall be applied for your purposes in the following year. None of your Members shall obtain any special privilege from any patent which may be obtained for any invention owned or controlled by you or under which you have the right to grant licenses or sublicenses. To the extent permitted by law you shall grant non-exclusive royalty-free

and irrevocable licenses to applicants who are citizens of the U. S. or are corporations organized and doing business in the U. S., provided, however, that such applicants shall meet the requirements of the A. E. C. with respect to the use of such licenses. Such licenses may contain provisions for sublicensing and such other terms as may be needed to effectuate the free use of the patent rights in the public interest.

Exhibit 5, enclosed with your letter dated December 28, 1955, contains a list of your present Membership which you state are individuals who are generally representative of your proposed corporate Members. Exhibit 6, contains a list of your present Board of Trustees who are elected by the Members.

The events leading up to your participation in nuclear power development beginning in April 1951, prior to your incorporation, and subsequent thereto, are summarized in your letter dated April 25, 1957, and supporting Exhibits 1 to 8, inclusive.

You propose to design, build and operate at an estimated cost of $30,511,000., exclusive of $10,000,000. research and development work completed by Atomic Power Development Associates, Inc. (A. P. D. A.), an experimental fast neutron breeder reactor, which will be built on land leased from the Detroit Edison Company near Monroe, Michigan. The reactor will produce heat energy (steam) and plutonium. This project will be financed by the receipt of membership contributions aggregating $25,511,000. and borrowings of $15,000,000. You also will receive payments from Detroit Edison Company for its purchases of steam pro-

duced by such reactor. Such payments will be made at the equivalent cost basis of steam produced by Detroit Edison in its own coal fuel system and turbine generator plant, which plant will be constructed by Detroit Edison at its own expense at an estimated cost of $14,000,000. You also will receive credits from the A. E. C. for plutonium produced in such reactor, pursuant to the A. E. Act of 1954, under which the A. E. C. has title to all special nuclear material.

You contend with respect to your ruling request (4) above that Membership dues and contributions received by you do not constitute gross income since you are required to expend them solely in pursuit of the development and demonstration of the practical and economic production

[6049]

and use of nuclear energy and, therefore, such dues and contributions are impressed with a trust when received and constitute a trust fund in your hands. In support of such contention you cite decisions in Broadcast Measurement Bureau, Inc. v. Com. 16 T. C. 988, Acq. C. B. 1951-2, page 2, and The Seven-Up Company v. Com., 14 T. C. 965, Acq. C. B. 1950-2, page 4.

In view of the foregoing on the basis of the information submitted it is ruled solely with respect to Membership payments received by you, that such payments do not constitute gross income under section 61 of the Code of 1954.

Pursuant to a power of attorney recorded in this office a copy of this letter has been furnished to Mr. Roswell

Magill, c/o Cravath, Swaine & Moore, 15 Broad Street, New York 5, New York.

Very truly yours,

H. T. SWARTZ
Director, Tax Rulings Division

[6050]

U. S. TREASURY DEPARTMENT
WASHINGTON 25

Jul 19 1957

Office of
Commissioner of Internal Revenue

Address Reply to
Commissioner of Internal Revenue
Washington 25, D. C.
and Refer to
T:R:C
WMD

RECEIVED
JUL 22 1957
C. H. G. & E. CORP.

Central Hudson Gas and Electric
Corporation,
Poughkeepsie, New York.

Gentlemen:

This is in reply to a letter dated April 25, 1957, signed by your representative Mr. Roswell Magill, in which a ruling is requested that amounts paid or incurred by you to Power Reactor Development Company (PRDC) as a Member of such corporation are deductible by you under section 174(a) of the Internal Revenue Code of 1954.

Based upon the information submitted it is ruled that amounts paid or incurred by you to PRDC as a Member thereof are deductible under section 174(a) of the Code, provided you properly adopt the method provided by such section and the regulations promulgated thereunder.

Pursuant to a power of attorney recorded in this office a copy of this letter has been furnished to Mr. Roswell Magill, c/o Cravath, Swaine & Moore, 15 Broad St., New York 5, New York.

Very truly yours,

H. T. SWARTZ,
Director, Tax Rulings Division.

APPLICATION EXHIBIT XLI (Sheet 1)
(First two sheets superseded by Application Exhibit XLI-A, Tr. [illegible])

Exhibit XLI
Sheet 3

Revised

CALCULATION OF PLUTONIUM REVENUE

YEAR	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	Reference Authority
Operating Data											
Reactor Power Level, mw Heat	300	300	350	350	400	430	430	430	430	430	
Load Factor	0.40	0.45	0.70	0.70	0.75	0.75	0.70	0.80	0.80	0.80	
Reactor Output, mw yrs.	120	135	245	245	300	322	301	344	344	344	
Burn-up, Per cent	1.0	1.5	2.0	2.0	2.5	3.0	3.0	3.0	3.0	3.0	AFDA, J. Hamm
Plutonium Production											
Gross Production, kg. yr.	15.16	45.33	72.18	89.89	151.02	124.86	117.79	125.63	159.77	206.27	
Net Production, kg. yr. Deduct 2% loss	14.86	44.43	70.74	88.10	148.00	122.37	115.44	123.12	156.58	202.15	
Plutonium Unit Price, $ Per gm.	44.20	37.10	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	(AEC schedule of Plutonium (Guaranteed Fair Prices, (dated May 31, 1957, 22 Fed. (Reg. 3985)
Plutonium Revenue, $1000	657	1648	2122	2643	4440	3671	3463	3694	4697	6065	
TOTAL										33,100	AFDA, J. Hamm

*Six Months Production at $44.20 and 6 months at $30.00/gr.

July 19, 1957

[6063]

Application Exhibit XLII

COMMONWEALTH ASSOCIATES INC.

209 E. Washington Ave.
Jackson, Michigan
STate 4-6111

July 19, 1957

ENRICO FERMI ATOMIC POWER PLANT
Revised Schedule of Plant Costs

Mr. R. W. Hartwell,
Power Reactor Development Company,
1911 First Street
Detroit 26 Michigan.

Dear Mr. Hartwell:

In accordance with conversations we have had recently, we are attaching a revised schedule of estimated plant cost expenditures by years which we have computed from a preliminary revision of the PRDC construction schedule. Our engineers have reviewed the delivery schedules and current construction progress and tentatively recommend a stretch-out of approximately eight months in the schedule. On this basis we have assumed that the reactor would go critical on September 1, 1960 instead of December 15, 1959 as previously planned. While we have not completed our revised construction schedule in detail, we believe that our review of the status of important components of the reactor indicates a stretch-out of from six to eight months. In our opinion a revision of the construction schedule indicating criticality on September 1, 1960 is conservative and the

resulting schedule would be realistic on the basis of progress to date and of presently anticipated component deliveries.

It is expected that the reactor vessel can be delivered to the job by January 15, 1958 and we have taken this into consideration in making this preliminary revision. We have also assumed that no erection work of major consequence will be carried out below the operating floor in the containment vessel during the component test operation to be conducted by ADPA. This assumption may be conservative and, if in fact such work can be carried on during the component test program, it may be possible to improve the schedule.

You will note that our estimated plant cost has increased $450,000 from the $32,400,000 which was presented in our December 31, 1956 estimate. This increase provides for 1961 tax payments and for interest during the longer construction and test period. In addition, we assume that overhead and administrative costs which we have never included in our construction estimate and which we understand have been estimated by your staff at $1,816,000 through December 31, 1960 would also have to be increased to cover the additional time allocated to construction and testing.

Yours very truly,

B. S. MOULTON,
B. S. Moulton,
Project Engineer.

BSM/hl

[6064]

PRDC—ENRICO FERMI ATOMIC POWER PLANT PROJECT
Total Estimated Plant Cost By Years
(Figures Are In Thousands of Dollars)

	1956	1957	1958	1959	1960	1961	Total
Site Improvements ..	$153.7	$ 246.3			$ 20.0	$ 18.9	$ 438.9
Structures	167.0	1,800.0	$1,700.0	$ 663.2	600.0	100.0	5,030.2
Reactor Plant Equip.		1,000.0	2,000.0	1,800.0	1,000.0	694.7	6,494.7
Liquid Metal System		500.0	1,000.0	1,500.0	1,875.0	150.0	5,025.0
Other Reactor Plant Equip.		200.0	1,300.0	1,600.0	1,258.0	50.0	4,408.0
Initial Supplies			300.0	809.0	278.0		1,378.0
Miscellaneous			150.0	250.0	244.0	50.0	694.0
Subtotal	$320.7	$3,746.3	$6,450.0	$6,613.2	$5,275.0	$1,063.6	$23,468.8
Construction Plant ..	$179.5	$ 450.0	$ 650.0	$ 675.0	$ 575.0	$ 447.5	$ 2,977.0
Spare Parts					160.0		160.0
Preoperation Tests ..				25.0	325.0		350.0
Personnel Training ..				150.0	350.0		500.0
Initial Low Load Operation					200.0	350.0	550.0
Interest		150.0	450.0	600.0	600.0	300.0	2,100.0
Local Taxes		6.5	50.0	125.0	300.0	187.7	669.2
Engineering	56.0	250.0	325.0	200.0	50.0	19.0	900.0
Subtotal	$556.2	$4,602.8	$7,925.0	$8,388.2	$7,835.0	$2,367.8	$31,675.0
Working Capital							1,175.0
Total Estimated Plant Cost							$32,850.0

* * *

Total Estimated Plant Cost by Years Excluding Working Capital of $1,175.0 and Allowance of $3,000.0 for Equipment and Devices to be Furnished by Atomic Power Development Associates

	1956	1957	1958	1959	1960	1961	Total
Subtotal	$556.2	$3,902.8	$6,325.0	$7,688.2	$7,835.0	$2,367.8	$28,675.0

ESim
7-1957

[6065]

Application Exhibit XLIII

POWER REACTOR DEVELOPMENT COMPANY
ENRICO FERMI ATOMIC POWER PLANT PROJECT

STATEMENT OF SOURCE AND APPLICATION OF CASH
DURING CONSTRUCTION PERIOD

PREPARED IN ACCORDANCE WITH
PRELIMINARY REVISED CONSTRUCTION SCHEDULE

Arthur Anderson & Co.
Detroit

July 19, 1957

[6066]

POWER REACTOR DEVELOPMENT COMPANY
ENRICO FERMI ATOMIC POWER PLANT PROJECT

STATEMENT OF SOURCE AND APPLICATION OF CASH
DURING CONSTRUCTION PERIOD

PREPARED IN ACCORDANCE WITH
PRELIMINARY REVISED CONSTRUCTION SCHEDULE

At the request of the Company, we have prepared statements based upon data furnished by Company personnel as of July 19, 1957, which statements show the source and application of cash during the construction period. This construction period includes the year 1956 and extends through the preoperational testing ending August 31, 1961, in accordance with a preliminary revised construction

schedule prepared by Commonwealth Associates, Inc., architects and engineers for the project.

Schedule No. 1 is a statement of source and application of cash during the construction period. Cash sources are based upon the commitment contracts for the amount of $23,540,000 in existence between the Company and its members, and upon the Loan Agreement between the Company and J. P. Morgan & Co., Incorporated, as agent for certain institutions.

Additional contributions to be made in 1961 by the utility member companies of Power Reactor Development Company in the total amount of $3,908,000 are to be held as a reserve for possible increases in construction or developmental costs and are not reflected in this schedule.

[6067]

Cash applications are based upon data furnished by Commonwealth Associates, Inc., architects and engineers for the project, and by Company personnel. Commonwealth Associates, Inc., furnished the estimated annual plant costs. Company personnel furnished the estimated remaining annual cash applications such as direct research and development cost, administrative expense, interest expense, and local taxes.

The Company has received a ruling dated July 19, 1957, from the Internal Revenue Service that the contributions from members during the construction period are not taxable income for Federal income tax purposes.

EXHIBIT XLIII

SCHEDULE NO. 1

STATEMENT OF SOURCE AND APPLICATION OF CASH

DURING CONSTRUCTION PERIOD

PREPARED IN ACCORDANCE WITH PRELIMINARY

REVISED CONSTRUCTION SCHEDULE

Particulars	Line No.	Year 1956	1957	1958	1959	1960	Eight Months Ending August 31, 1961	Total
Source of cash-								
Contributions (see Notes 1 and 2)	1	$2,051,400	$ -	$ 1,000,000	$ 7,895,800	$12,592,800	$ -	$23,540,000
Long-term loans	2	-	8,000,000	7,000,000	-	-	-	15,000,000
Total source of cash	3	$2,051,400	$8,000,000	$ 8,000,000	$ 7,895,800	$12,592,800	$ -	$38,540,000
Application of cash-								
Plant expenditures (see Schedule No. 2)	4	$ 806,200	$4,146,300	$ 6,125,000	$ 7,313,200	$ 7,285,000	$ 2,400,100	$28,075,800
Interest	5	-	150,000	450,000	600,000	600,000	300,000	2,100,000
Property taxes	6	-	6,500	50,000	125,000	300,000	187,700	669,200
Direct research and development cost	7	-	1,500,000	2,500,000	1,000,000	-	-	5,000,000
Total application of cash (see Note 3)	8	$ 806,200	$5,802,800	$ 9,125,000	$ 9,038,200	$ 8,185,000	$ 2,887,800	$35,845,000
Net cash increase (decrease) during period	9	$1,245,200	$2,197,200	$(1,125,000)	$(1,142,400)	$ 4,407,800	$(2,887,800)	$ 2,695,000
Cash balance - end of period	10	$1,245,200	$3,442,400	$ 2,317,400	$ 1,175,000	$ 5,582,800	$ 2,695,000	

NOTES:

(1) A contribution in kind to the extent of $1,000,000 is reflected in the contributions to be received in 1958 as the goods and services to be contributed will be required in that year under the construction schedule.

(2) Additional contributions to be made in 1961 by utility member companies of PRDC in the total amount of $3,908,000 are to be held as a reserve for possible increases in construction or development costs and are not reflected in this statement.

(3) Total estimated project consists of-

Total application of cash by PRDC (see Line 8)	$35,845,000
Working capital	1,175,000
Total PRDC cash requirement	$37,020,000
Value to PRDC of research, development, test devices and equipment to be provided by Atomic Power Development Associates	7,000,000
Total estimated project	$44,020,000

CALCULATION OF PLANT EXPENDITURES

PREPARED IN ACCORDANCE WITH PRELIMINARY REVISED CONSTRUCTION SCHEDULE

Line No.	Particulars	Year 1956	1957	1958	1959	1960	Eight Months Ending August 31, 1961	Total
1	Total estimated plant cost per Commonwealth Associates, Inc.	$550,200	$3,902,800	$[illegible]	$7,088,200	$7,[illegible]	$2,367,800	$28,[illegible]75,000
	Adjustments-							
2	Deduct- Interest during construction included in estimated plant cost		(150,000)	(450,000)	([illegible]00,000)	(600,000)	(300,000)	(2,100,000)
3	Deduct- Property taxes included in estimated plant cost		(2,500)	(50,000)	(1[illegible],300)	(300,000)	(187,[illegible]0)	(669,200)
4	Add- Administrative expenses	250,000	400,000	300,000	[illegible],200	350,000	520,[illegible]0	2,170,000
5	Plant expenditures	$8[illegible],[illegible]00	[illegible],[illegible]00	$[illegible],[illegible]25,000	$7,[illegible]3[illegible],[illegible]00	$7,[illegible]8[illegible],000	$2,400,100	$28,[illegible]75,200

[6070]

Application Exhibit XLIV

POWER REACTOR DEVELOPMENT COMPANY
ENRICO FERMI ATOMIC POWER PLANT PROJECT

STATEMENT OF SOURCE AND APPLICATION OF CASH
DURING TEN YEAR OPERATING PERIOD

FOLLOWING COMPLETION OF CONSTRUCTION AND TESTING
IN ACCORDANCE WITH PRELIMINARY REVISED
CONSTRUCTION SCHEDULE

Arthur Anderson & Co.
Detroit

July 19, 1957

[6071]

POWER REACTOR DEVELOPMENT COMPANY
ENRICO FERMI ATOMIC POWER PLANT PROJECT

STATEMENT OF SOURCE AND APPLICATION OF CASH
DURING TEN YEAR OPERATING PERIOD

FOLLOWING COMPLETION OF CONSTRUCTION AND TESTING
IN ACCORDANCE WITH PRELIMINARY REVISED
CONSTRUCTION SCHEDULE

At the request of the Company, we have prepared statements based upon data furnished by Company personnel as of July 19, 1957, which statements show the source and application of cash during a ten year period of operations beginning September 1, 1961, and following completion and testing of the reactor plant in accordance with a preliminary

revised construction schedule prepared by Commonwealth Associates, Inc., architects and engineers for the project.

Schedule No. 1 is a statement of source and application of cash during the ten year operating period. Cash sources and cash applications for the period are based upon data furnished by Company personnel. Cash balance at September 1, 1961, is a carry-forward from the statement of source and application of cash during the construction period.

Following the instructions of the Company, this statement reflects the receipts from member companies for repayment of the $15,000,000 long-term loan as taxable income to the Company.

[6072]

In determining the Federal income tax liability, the cash sources and cash applications for the period of operations as furnished by Company personnel were adjusted to reflect depreciation expense.

The Company has received a ruling dated July 19, 1957, from the Internal Revenue Service that contributions during the construction period are not taxable income to the Company. In computing the depreciation expense, the tax basis of the plant for depreciation purposes was decreased in an amount equal to the contributions during the construction period. This adjustment represents conservative tax accounting for money contributed to a corporation for plant construction.

The Company engineers furnished the estimated life of the plant and net salvage.

[6073]

STATEMENT OF SOURCE AND APPLICATION OF CASH

DURING TEN YEAR OPERATING PERIOD

FOLLOWING COMPLETION OF CONSTRUCTION AND TESTING

IN ACCORDANCE WITH PRELIMINARY REVISED CONSTRUCTION SCHEDULE

Particulars	Line No.	Twelve Month Period Ending August 31							
		1962	1963	1964	1965	1966	1967	1968	1969
Year of operation		1	2	3	4	5	6	7	8
Source of cash-									
Operating revenues-									
Steam sales	1	$ 1,191,000	$1,537,000	$3,878,000	$3,649,000	$ 4,644,000	$ 5,338,000	$ 5,182,000	$ 5,867,000
Sales of plutonium	2	622,000	1,333,000	2,122,000	2,643,000	4,440,000	3,671,000	3,463,000	3,694,000
Temporary loans (see Schedule No. 6)	3	1,165,000	2,515,000	336,000	479,000	-	-	-	-
Receipts from member companies for repayment of long-term loans	4	-	-	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000
	5	$ 2,978,000	$5,385,000	$8,336,000	$8,771,000	$11,084,000	$11,009,000	$10,645,000	$11,561,000
Application of cash-									
Operating expenses-									
Production costs	6	$ 1,473,000	$1,536,000	$1,802,000	$1,832,000	$ 1,977,000	$ 2,064,000	$ 2,053,000	$ 2,180,000
Core processing costs	7	527,000	697,000	715,000	821,000	714,000	769,000	713,000	754,000
Blanket processing costs	8	135,000	295,000	414,000	474,000	1,011,000	604,000	572,000	622,000
Additional fuel cycle costs	9	844,000	1,247,000	1,748,000	2,053,000	2,963,000	3,436,000	3,112,000	3,298,000
Property taxes	10	690,000	690,000	690,000	690,000	690,000	690,000	690,000	690,000
Insurance	11	149,000	149,000	149,000	149,000	149,000	149,000	149,000	149,000
Interest on long-term loans (see Schedule No. 5)	12	652,000	653,000	630,000	544,000	457,000	370,000	282,000	196,000
Interest on temporary loans (see Schedule No. 6)	13	28,000	118,000	188,000	208,000	197,000	155,000	113,000	64,000
Payment of principal on long-term loans	14	-	-	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000
Payment of principal on temporary loans (see Schedule No. 6)	15	-	-	-	-	926,000	772,000	961,000	1,042,000
Federal income tax payments (see Schedule No. 2)	16	-	-	-	-	-	-	-	566,000
	17	$ 4,498,000	$5,385,000	$8,336,000	$8,771,000	$11,084,000	$11,009,000	$10,645,000	$11,561,000
Net cash increase (decrease) during year	18	$(1,520,000)	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cash balance - September 1, 1961	19	$ 2,695,000							
Cash balance - end of period	20	$ 1,175,000	$1,175,000	$1,175,000	$1,175,000	$ 1,175,000	$ 1,175,000	$ 1,175,000	$ 1,175,000

EXHIBIT XLIV

SCHEDULE NO. 1

1970	1971	Total
9	10	
$ 6,015,000	$ 6,165,000	$43,466,000
4,697,000	6,065,000	32,750,000
-	-	4,495,000
3,000,000	-	15,000,000
$13,712,000	$12,230,000	$95,711,000
$ 2,218,000	$ 2,258,000	$19,393,000
820,000	810,000	7,340,000
729,000	1,132,000	5,988,000
3,705,000	3,765,000	26,171,000
690,000	690,000	6,900,000
149,000	149,000	1,490,000
99,000	-	3,883,000
24,000	1,000	1,096,000
3,000,000	-	15,000,000
613,000	181,000	4,495,000
1,665,000	2,234,000	4,465,000
$13,712,000	$11,220,000	$96,221,000
$ -	$ 1,010,000	$ (510,000)
$ 1,175,000	$ 2,185,000	$ 2,185,000

CALCULATION OF FEDERAL INCOME TAX PAYMENTS

DURING TEN YEAR OPERATING PERIOD

FOLLOWING COMPLETION OF CONSTRUCTION AND TESTING

IN ACCORDANCE WITH PRELIMINARY REVISED CONSTRUCTION SCHEDULE

Particulars	Line No.	Twelve Month Period Ending August 31							
		1962	1963	1964	1965	1966	1967	1968	1969
Year of operation		1	2	3	4	5	6	7	8
Revenues-									
Steam sales	1	$ 1,191,000	$ 1,537,000	$3,878,000	$3,649,000	$ 4,644,000	$ 5,338,000	$ 5,182,000	$ 5,867,000
Sales of plutonium	2	622,000	1,333,000	2,122,000	2,643,000	4,440,000	3,671,000	3,463,000	3,694,000
Receipts from member companies for repayment of long-term loans	3	-	-	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000
Total revenues	4	$ 1,813,000	$ 2,870,000	$8,000,000	$8,292,000	$11,084,000	$11,009,000	$10,645,000	$11,561,000
Expenses-									
Production costs	5	$ 1,473,000	$ 1,536,000	$1,802,000	$1,832,000	$ 1,977,000	$ 2,064,000	$ 2,053,000	$ 2,180,000
Core processing costs	6	527,000	697,000	715,000	821,000	714,000	769,000	713,000	754,000
Blanket processing costs	7	135,000	295,000	414,000	474,000	1,011,000	604,000	572,000	622,000
Additional fuel cycle costs	8	844,000	1,247,000	1,748,000	2,053,000	2,963,000	3,436,000	3,112,000	3,298,000
Property taxes	9	690,000	690,000	690,000	690,000	690,000	690,000	690,000	690,000
Insurance	10	149,000	149,000	149,000	149,000	149,000	149,000	149,000	149,000
Interest on long-term loans (see Schedule No. 5)	11	652,000	653,000	630,000	544,000	457,000	370,000	282,000	196,000
Interest on temporary loans (see Schedule No. 6)	12	28,000	118,000	188,000	208,000	197,000	155,000	113,000	64,000
Depreciation (see Schedule No. 4)	13	730,000	731,000	730,000	731,000	730,000	731,000	730,000	731,000
Amortization of direct research and development costs	14	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000
Total expenses	15	$ 5,728,000	$ 6,616,000	$7,566,000	$8,002,000	$ 9,388,000	$ 9,468,000	$ 8,914,000	$ 9,184,000
Net taxable income (loss)	16	$(3,915,000)	$(3,746,000)	$ 434,000	$ 290,000	$ 1,696,000	$ 1,541,000	$ 1,731,000	$ 2,377,000
Federal income tax liability (see Schedule No. 3)	17	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,231,000
Federal income tax payments (see Schedule No. 3)	18	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 566,000

EXHIBIT XLIV

SCHEDULE NO. 2

1970	1971	Total
9	10	
$ 6,015,000	$ 6,165,000	$43,466,000
4,697,000	6,065,000	32,750,000
3,000,000	-	15,000,000
$13,712,000	$12,230,000	$91,216,000
$ 2,218,000	$ 2,258,000	$19,393,000
820,000	810,000	7,340,000
729,000	1,132,000	5,988,000
3,705,000	3,765,000	26,171,000
690,000	690,000	6,900,000
149,000	149,000	1,490,000
99,000	-	3,883,000
24,000	1,000	1,096,000
730,000	731,000	7,305,000
500,000	500,000	5,000,000
$ 9,664,000	$10,036,000	$84,566,000
$ 4,048,000	$ 2,194,000	$ 6,650,000
$ 2,099,000	$ 1,135,000	$ 4,465,000
$ 1,665,000	$ 2,234,000	$ 4,465,000

SUPPORTING CALCULATIONS OF FEDERAL INCOME TAXES

DURING TEN YEAR OPERATING PERIOD

FOLLOWING COMPLETION OF CONSTRUCTION AND TESTING

IN ACCORDANCE WITH PRELIMINARY REVISED CONSTRUCTION SCHEDULE

Particulars	Line No.	Twelve Month Period Ending August 31							
		1962	1963	1964	1965	1966	1967	1968	
Year of operation		1	2	3	4	5	6	7	
Net taxable income (loss) (see Line 16, Schedule No. 2)	1	$(3,915,000)	$(3,746,000)	$434,000	$290,000	$1,696,000	$1,541,000	$1,731,000	$2
Loss carry-forward-									
1962 - 2 years to 1964	2	434,000		(434,000)					
3 years to 1965	3	290,000			(290,000)				
4 years to 1966	4	1,696,000				(1,696,000)			
5 years to 1967	5	1,495,000					(1,495,000)		
1963 - 4 years to 1967	6		46,000				(46,000)		
5 years to 1968	7		1,731,000					(1,731,000)	
Net taxable income (loss) after carry-forward	8	$ -	$(1,969,000)	$ -	$ -	$ -	$ -	$ -	$2
Computation of tax liability-									
Net taxable income subject to tax in current year	9								$2
Tax rate	10								
	11								$1
Less- Statutory exemption	12								
Federal income tax liability (see Line 17, Schedule No. 2)	13								$1
Federal income tax payments-									
Payable in current year - 50% of excess over $100,000	14								$
Payable in subsequent year - balance	15								
Entire tax liability for the twelve months ending August 31, 1971, has been considered payable in that year	16								
Federal income tax payments (see Line 18, Schedule No. 2)	17								$

EXHIBIT XLIV

SCHEDULE NO. 3

od Ending August 31

1967	1968	1969	1970	1971
6	7	8	9	10
$1,541,000	$1,731,000	$2,377,000	$4,048,000	$2,194,000
(1,495,000)				
(46,000)				
	(1,731,000)			
$ -	$ -	$2,377,000	$4,048,000	$2,194,000
		$2,377,000	$4,048,000	$2,194,000
		52%	52%	52%
		$1,236,500	$2,104,500	$1,140,500
		5,500	5,500	5,500
		$1,231,000	$2,099,000	$1,135,000
		$ 566,000	$1,000,000	$
			665,000	1,099,000
				1,135,000
		$ 566,000	$1,665,000	$2,234,000

[6076]

Schedule No. 4

CALCULATION OF ANNUAL DEPRECIATION
DURING TEN YEAR OPERATING PERIOD

FOLLOWING COMPLETION OF CONSTRUCTION AND TESTING
IN ACCORDANCE WITH PRELIMINARY REVISED
CONSTRUCTION SCHEDULE

Plant expenditures	$28,675,000
Add—Administrative expense	2,170,000
Total plant	$30,845,000
Less—Contributions during construction period	23,540,000
Net depreciable plant—adjusted basis	$ 7,305,000
Annual depreciation—based on ten year life and assuming that salvage will be equal to cost of removal	$ 730,500

[6077]

Schedule No. 5

CALCULATION OF INTEREST ON LONG-TERM BANK LOANS DURING TEN YEAR OPERATING PERIOD

FOLLOWING COMPLETION OF CONSTRUCTION AND TESTING IN ACCORDANCE WITH PRELIMINARY REVISED CONSTRUCTION SCHEDULE

Twelve Month Period Ending August 31	*Year of Operation*	*Date of Payment*	*Loans Outstanding Amount*	*Number of Months*	*Amount*	*Total*
1962	1	12-31	$15,000,000	6	$326,000	
		6-30	15,000,000	6	326,000	$652,000
1963	2	12-31	15,000,000	6	$326,500	
		6-30	15,000,000	6	326,500	$653,000
1964	3	12-31	15,000,000	6	$326,000	
		6-30	14,000,000	6	304,000	$630,000
1965	4	12-31	13,000,000	6	$282,500	
		6-30	12,000,000	6	261,500	$544,000
1966	5	12-31	11,000,000	6	$239,000	
		6-30	10,000,000	6	218,000	$457,000
1967	6	12-31	9,000,000	6	$196,000	
		6-30	8,000,000	6	174,000	$370,000
1968	7	12-31	7,000,000	6	$152,000	
		6-30	6,000,000	6	130,000	$282,000
1969	8	12-31	5,000,000	6	$108,500	
		6-30	4,000,000	6	87,500	$196,000
1970	9	12-31	3,000,000	6	$ 66,000	
		6-30	1,500,000	6	33,000	$ 99,000
1971	10					$ —

(6079)

APPLICATION EXHIBIT XLV

POWER REACTOR DEVELOPMENT COMPANY

Exhibit XLV
Sheet 1

COMPARISON OF CONSTRUCTION ESTIMATES AND COMMITMENTS
(Direct Costs Only)

	(1)	(2)	(3)	(4)	Commitment (5)	Commitment (6)	Contingencies (7)	Contingencies (8)	(9) (Col. 1+7-2)
	CAI Est.(1)	Order or Commitment	% of Est. Cost	Expended to 5-31-57	Below Est.	Above Est.	Provided	Remaining (Overrun)	Net Balance, Inc. Contingency (Overrun)
Structures & Improvements									
A-1 Dredge & Grade Fill	$ 135,000	$ 152,580	113	$ 152,580	$ -	$ 17,580	$ 13,500	$ (4,080)	$ (4,080)
A-8 Yard Lighting	10,000	6,370	64	6,370	3,630	-	1,500	1,500	5,130
Reactor Plant Structures									
B-1 Excavation, Grouting Foundations, Etc.	269,850	238,646	96	226,378	11,204		25,000	25,000	36,204
Dewatering Excavation	-	60,000		48,000		60,000	-	-	(60,000)
B-2 Containment Vessel	735,250(2)	800,000(2)	108	185,600		64,750	73,525	8,775	8,775
B-3 Internal Structure	495,900	375,000	76	-	119,500		49,450	49,450	168,950
Reactor Plant Equipment									
C-7 Overhead Crane	200,000(2)	220,000	110	-		20,000	30,000	10,000	10,000
Liquid Metal System									
D-3 Intermediate Heat Exchanger	925,000	1,700,000	183	-		775,000	277,500	(497,500)	(497,500)
D-5 2 Loops Primary Sodium Piping	150,000(2)	220,500(2)	147	-		70,500	45,000	(25,500)	(25,500)
D-7 Secondary Containment, Primary Sodium System	70,000(2)	220,000(2)	300	-		150,000	21,000	(129,000)	(129,000)
D-9 Secondary Containment Secondary Sodium System	60,000(2)	-					18,000	18,000	78,000
Liquid Metal Storage									
F-1 Storage Tanks	100,000	48,700	48		51,300		30,000	30,000	81,300
Other Reactor Plant Equip.									
G-5 Instrumentation	128,000	128,000	100	-			38,400	38,400	38,400
	$3,257,600	$4,169,796					$622,875		$(289,321)

(1) - Portion of Estimate Covered by Commitment
(2) - Erected Cost

RECAP:-		
CAI Estimates	$3,257,600	
Contingency Allowances	622,875	
	3,880,475	100%
Over Run	289,321	7.4%
Commitments	$4,169,796	

[6079]

6079

CALCULATION OF TEMPORARY LOANS AND INTEREST

DURING TEN YEAR OPERATING PERIOD

FOLLOWING COMPLETION OF CONSTRUCTION AND TESTING

IN ACCORDANCE WITH PRELIMINARY REVISED CONSTRUCTION SCHEDULE

Particulars	Line No.	Twelve Month Period Ending August 31						
		1962	1963	1964	1965	1966	1967	1968
Year of operation		1	2	3	4	5	6	7
Cash balance - beginning of period	1	$ 2,695,000	$ 1,175,000	$1,175,000	$ 1,175,000	$ 1,175,000	$ 1,175,000	$ 1,175,000
Net cash increase (decrease) during period before temporary loans-								
Sources of cash - see Line 5, Schedule No. 1	2	$ 2,978,000	$ 5,385,000	$8,336,000	$ 8,771,000	$11,084,000	$11,009,000	$10,645,000
Less- Temporary loans - see Line 3, Schedule No. 1	3	1,165,000	2,515,000	336,000	479,000	-	-	-
	4	$ 1,813,000	$ 2,870,000	$8,000,000	$ 8,292,000	$11,084,000	$11,009,000	$10,645,000
Application of cash - see Line 17, Schedule No. 1	5	$ 4,498,000	$ 5,385,000	$8,336,000	$ 8,771,000	$11,084,000	$11,009,000	$10,645,000
Less- Interest on temporary loans, see Line 13, Schedule No. 1	6	28,000	118,000	188,000	208,000	197,000	155,000	113,000
Payment of principal on temporary loans, see Line 15, Schedule No. 1	7	-	-	-	-	926,000	772,000	961,000
	8	$ 4,470,000	$ 5,267,000	$8,148,000	$ 8,563,000	$ 9,961,000	$10,082,000	$ 9,571,000
Net cash increase (decrease) from operations (Line 4, less Line 8)	9	$(2,657,000)	$(2,397,000)	$ (148,000)	$ (271,000)	$ 1,123,000	$ 927,000	$ 1,074,000
Cash requirement (excess) before interest payment and after providing working capital of $1,175,000	10	$ 1,137,000	$ 2,397,000	$ 148,000	$ 271,000	$(1,123,000)	$ (927,000)	$(1,074,000)
Interest on temporary loans-								
Temporary loans - beginning of period	11	$ -	$ 1,165,000	$3,680,000	$ 4,016,000	$ 4,495,000	$ 3,569,000	$ 2,797,000
Average amount of current period cash requirement (excess) outstanding during period	12	569,000	1,198,000	74,000	136,000	(562,000)	(464,000)	(537,000)
	13	$ 569,000	$ 2,363,000	$3,754,000	$ 4,152,000	$ 3,933,000	$ 3,105,000	$ 2,260,000
Interest rate	14	5%	5%	5%	5%	5%	5%	5%
Interest on temporary loans, see Line 13, Schedule No. 1	15	$ 28,000	$ 118,000	$ 188,000	$ 208,000	$ 197,000	$ 155,000	$ 113,000
Required temporary loan (repayment) - current period, see Lines 3 and 15, Schedule No. 1	16	$ 1,165,000	$ 2,515,000	$ 336,000	$ 479,000	$ (926,000)	$ (772,000)	$ (961,000)
Temporary loans - balance at end of current period	17	$ 1,165,000	$ 3,680,000	$4,016,000	$ 4,495,000	$ 3,569,000	$ 2,797,000	$ 1,836,000
Cash balance - end of period (Lines 1 plus 9 less 15 plus 16) - see Line 20, Schedule No. 1	18	$ 1,175,000	$ 1,175,000	$1,175,000	$ 1,175,000	$ 1,175,000	$ 1,175,000	$ 1,175,000

EXHIBIT XLIV

SCHEDULE NO. 6

Ust. 31

1968	1969	1970	1971
7	8	9	10
$ 1,175,000	$ 1,175,000	$ 1,175,000	$ 1,175,000
$10,645,000	$11,561,000	$13,712,000	$12,230,000
-	-	-	-
$10,645,000	$11,561,000	$13,712,000	$12,230,000
$10,645,000	$11,561,000	$13,712,000	$11,220,000
113,000	64,000	24,000	1,000
961,000	1,042,000	613,000	181,000
$ 9,571,000	$10,455,000	$13,075,000	$11,038,000
$ 1,074,000	$ 1,106,000	$ 637,000	$ 1,192,000
$(1,074,000)	$(1,106,000)	$ (637,000)	$(1,192,000)
$ 2,797,000	$ 1,836,000	$ 794,000	$ 181,000
(537,000)	(553,000)	(319,000)	(154,000)
$ 2,260,000	$ 1,283,000	$ 475,000	$ 27,000
5%	5%	5%	5%
$ 113,000	$ 64,000	$ 24,000	$ 1,000
$ (961,000)	$(1,042,000)	$ (613,000)	$ (181,000)
$ 1,836,000	$ 794,000	$ 181,000	$ -
$ 1,175,000	$ 1,175,000	$ 1,175,000	$ 2,185,000

[6080]

STRUCTURES AND IMPROVEMENTS

Item A-1 Dredge and Grade Fill

Work has been completed by the Charles J. Rogers Company. This required the removal of about 150,000 cu. yds. of muck and the placement of 350,000 cu. yds. of clay. Cost was shared with Detroit Edison on a 50-50 basis under provisions of Service Agreement (Exhibit XXVI). Cost shown represents PRDC share of total costs.

Item A-8 Yard Lighting

Work has been completed by Electric Machinery and Maintenance Company. Cost was shared with Detroit Edison on a 50-50 basis under provisions of Service Agreement (Exhibit XXVI). Cost shown represents PRDC share of total cost.

REACTOR PLANT STRUCTURES

Item B-1 Excavation, Grouting, Foundations, etc.

Pre-grouting work has been completed by Raymond Concrete Pile Co. Excavation work has been completed by Charles J. Rogers Company. Concrete foundation required for erection of the containment vessel has been completed by Gratton Construction Co. Back fill and waterproofing also was performed by Gratton. Additional external concrete foundation work must be done after the containment vessel is tested. It is estimated that about 53 per cent of work covered by this item is complete.

6080

Item—Dewatering Excavation

Water which seeps into the excavated foundation hole and then around the concrete which is in place must be pumped out. This item was not included specifically in the estimate. Pumping is being done by

[6081]

United Engineers & Constructors' field force, on work orders issued by PRDC.

Item B-2 Containment Vessel

Erection of the containment vessel under contract of December 24, 1956 between PRDC and Chicago Bridge & Iron Co. has progressed to the point where essentially all of the extras are settled (including price for two air locks at total of $43,800). Chicago Bridge & Iron is erecting the vessel and will complete the work by September 1, 1957. Insulation bids are in but no award has been made. Total order amount of $800,000 includes allowance for escalation in accordance with CB&I contract, and also includes amounts bid on insulation.

B-3 Internal Structure

An award for steel plate shielding was made to the R. C. Mahon Co. Structural Steel was purchased from Ingalls Iron Works. The material covered by these two orders, placed on a firm price basis, accounts for 59 per cent of the material listed under this item in the construction estimate.

REACTOR PLANT EQUIPMENT

Item C-7 Overhead Crane

The crane has been purchased complete from the Whiting Corporation under contract of December 19, 1956. Erection will be done by United Engineers & Constructors, Inc.

LIQUID METAL SYSTEM

D-3 Intermediate Heat Exchangers

On June 4, 1957 Alco Products, Inc. was awarded a contract for the three intermediate heat exchangers. These units will be installed by United Engineers & Constructors, Inc.

[6082]

D-5 Two Loops Primary Sodium Piping

Fabrication and erection of the two loops of primary sodium piping will be done by the Grinnell Company under an award on competitive bids of June 21, 1957. Since APDA will provide the other loop, the portion of the item borne by PRDC is about 67 per cent of the total listed. Fabrication of the piping is on a fixed price basis at $126,000 while erection is to be done on a unit price basis. Commonwealth Associates have estimated the cost of erection at $94,500 based on the erection contract terms.

D-7 Secondary Containment—Primary Sodium System

Design, fabrication and erection of the secondary containment piping is being done under the award to

Grinnell Company, dated June 21, 1957. Commonwealth Associates has estimated over-all cost on the basis of this contract.

E-9 Secondary Containment—Secondary Sodium System

This item, which is included in the cost estimate, has now been eliminated from the design since the secondary system is non-radioactive and will, to a large extent, be installed in a tunnel.

LIQUID METAL STORAGE

F-1 Storage Tanks

An award based on competitive bids was made on June 25, 1957 to Philadelphia Coppersmithing Company for the three large sodium storage tanks which represent 67 per cent of the material included in this item.

OTHER REACTOR PLANT EQUIPMENT

G-6 Instrumentation

Non-nuclear instrumentation for the primary sodium system and the sodium storage facility has been purchased from Leeds and Northrup Company. It is estimated that this instrumentation represents about 14 per cent of the material listed.

[6273]

Application Exhibit XXI-A

(SUPPLEMENT TO APDA-PRDC AGREEMENT)

COPY

TELEPHONE WOODWARD 2-9510

ATOMIC POWER DEVELOPMENT ASSOCIATES, INC.
1911 FIRST STREET
Detroit 26, Michigan

March 28, 1957

Mr. R. George Rincliffe
Executive Vice President
Power Reactor Development Company
c o The Philadelphia Electric Company
1000 Chestnut Street
Philadelphia 7, Pa.

Dear Sir:

APDA hereby offers to enter into an agreement with Power Reactor Development Company, supplemental to the agreement between them, dated as of December 14, 1956, as follows:

"Referring to the provisions of Article III of the agreement between the parties entered into as of December 14, 1956, looking toward further agreement, APDA hereby makes an unconditional commitment to supply to PRDC not less than $7,000,000 worth of services and equipment provided for by said agreement (it being contemplated that this will be done by the

end of 1959) and PRDC agrees to go forward with construction of the reactor plant and agrees to use its best efforts to complete the construction and to operate the reactor plant."

If this offer is acceptable to PRDC, will you please so indicate by signing the enclosed copy of this letter and returning it to me at your earliest convenience.

Very truly yours,

JOHN R. COFFRAN
Title *Vice President*

ATOMIC POWER DEVELOPMENT ASSOCIATES, INC.

Accepted:
Power Reactor Development Company

By Ernest R. Acker
Vice President

Dated: March 28, 1957

[6274]

Application Exhibit XXII-A

GUARANTY AGREEMENT

Guaranty Agreement dated March 30, 1957 between CENTRAL HUDSON GAS & ELECTRIC CORPORATION, THE CINCINNATI GAS & ELECTRIC COMPANY, COLUMBUS AND SOUTHERN OHIO ELECTRIC COMPANY, CONSUMERS POWER COMPANY, DELAWARE POWER & LIGHT COMPANY, THE DETROIT EDISON COMPANY, IOWA-ILLINOIS GAS AND

ELECTRIC COMPANY, LONG ISLAND LIGHTING COMPANY, PHILADELPHIA ELECTRIC COMPANY, POTOMAC ELECTRIC POWER COMPANY, ROCHESTER GAS AND ELECTRIC CORPORATION, THE SOUTHERN COMPANY, WISCONSIN ELECTRIC POWER COMPANY, each acting severally and not jointly and herein called the "Guarantors"; J. P. MORGAN & CO. INCORPORATED, BANKERS TRUST COMPANY, THE CHASE MANHATTAN BANK, THE FIRST NATIONAL CITY BANK OF NEW YORK, CITY BANK FARMERS TRUST COMPANY, each acting severally and not jointly as trustee of various pension trusts, and BANKERS TRUST COMPANY as Trustee under agreement with American Brake Shoe Company dated May 17, 1940, herein called the "Banks"; J. P. MORGAN & CO. INCORPORATED, as Agent for all the Banks, herein called the "Agent"; and POWER REACTOR DEVELOPMENT COMPANY, herein called the "Company".

WHEREAS, the Company has executed and delivered to the Banks and the Agent a Loan Agreement dated October 30, 1956, in the form of Exhibit A hereto, herein called the "Loan Agreement", and proposes to borrow thereunder $15,000,000 to be evidenced by its promissory notes (being in the form set forth in Exhibit A and herein called the "Notes") maturing July 1, 1970 and bearing interest at 4.35% per annum; and

WHEREAS, each of the Guarantors is a member or a parent of a member of the Company or a contributor to the Company and each of the Guarantors is interested in furthering the work of the Company; and

WHEREAS, in order to induce each of the Banks and the Agent to execute said Loan Agreement and to induce the Banks to make the loans therein provided for, each of the Guarantors is willing to guarantee, severally and not jointly, the payment when due of a percentage of the principal of and interest on the Notes as hereinafter provided; and

WHEREAS, due corporate proceedings have been taken by each Guarantor and all necessary authorizations or approvals of governmental administrative agencies or other regulatory bodies have been obtained with respect to the execution on its behalf of this agreement and its unconditional several guaranty herein provided for;

The Guarantors severally covenant and agree as follows:

FIRST: Each Guarantor hereby severally agrees with the Banks and the Agent to guarantee and does hereby unconditionally guarantee, the due and punctual payment of the percentage set opposite its name below of the principal of and interest on each and every one of the Notes and of the indebtedness represented thereby, as and when the same shall respectively become due and payable, whether at maturity or by declaration or otherwise, pursuant to the provisions of the Notes and of the Loan Agreement, and in case the Company shall fail to pay the principal of or interest on any of the

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Notes and of the indebtedness represented thereby, as and when the same shall respectively become due and payable, whether at maturity or by declaration or otherwise, pursuant to the provisions of the Notes and the Loan Agree-

ment, each Guarantor severally covenants and agrees duly and punctually to pay, in the manner provided in Section 2.8 of the Loan Agreement, the percentage of the same set opposite its name below:

Name of Guarantor	Percentage Guaranteed
Central Hudson Gas & Electric Corporation	.80
The Cincinnati Gas & Electric Company	1.00
Columbus and Southern Ohio Electric Company	1.00
Consumers Power Company	10.00
Delaware Power & Light Company	1.20
The Detroit Edison Company	58.84
Iowa-Illinois Gas and Electric Company	.48
Long Island Lighting Company	2.48
Philadelphia Electric Company	10.00
Potomac Electric Power Company	3.20
Rochester Gas and Electric Corporation	1.80
The Southern Company	8.00
Wisconsin Electric Power Company	1.20

Each Guarantor agrees that every payment made by it on account of principal of or interest on the Notes pursuant to its guaranty herein shall constitute a contribution by it to the Company to aid it in its scientific research and development and otherwise to further the work of the Company and in no event shall be deemed an advance or loan to the Company which is subject to repayment or which creates a claim of any kind against the Company.

SECOND: Each Guarantor hereby authorizes and directs the Company, in the name and on behalf of such Guarantor, to cause to be endorsed on the back of each Note executed and delivered by it a legend in the form set forth in Annex B to the Loan Agreement.

THIRD: Each Guarantor assents to the terms, covenants and conditions of the Notes and of the Loan Agreement and irrevocably waives presentation, demand or protest of any of the Notes and any and all notice of any such presentation, demand or protest. The obligation of each Guarantor hereunder or under its guaranty of a percentage of the principal of and interest on each of the Notes shall not be affected by the recovery of any judgment against the Company or any successor corporation, or by the levy of execution under any such judgment, or by any action or proceeding taken by the Agent or by the holder or holders of any of the Notes, either under the Notes or under the Loan Agreement, for the enforcement thereof or in the exercise of any right or power given or conferred thereby, or by any delay, failure, or omission upon the part of the Agent to enforce any of the rights or powers given or conferred by the Loan Agreement or this agreement, or by any delay, failure or omission on the part of any holder or holders of the Notes to enforce any right of such holder or holders against the Company or any successor corporation, or by any action of the Agent, or by any holder or holders of said Notes in granting indulgence to the Company or to any successor corporation or in granting any extension of time of payment, or in waiving or acquiescing in any default upon the part of the Company or any successor corporation under the Notes,

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or under the Loan Agreement, or by any breach, alteration, change or enforcement of any of the terms and provisions of the Loan Agreement or otherwise in respect thereof or

by any other act or delay or failure to act or by any other thing which may or might in any manner or to any extent vary the risk of any Guarantor under this agreement or under the guaranty of its percentage of the principal of and interest on said Notes, in accordance herewith; it being the purpose and intent of the parties hereto that the said several guaranties and the several obligations of the Guarantors hereunder shall be absolute and unconditional under any and all circumstances, and shall not be discharged except by payment as herein provided, and then only to the extent of such payment or payments.

FOURTH: Each Guarantor agrees that its right to payment of principal of and interest on any indebtedness that may hereafter exist from the Company to them is hereby expressly subordinated to the prior payment of the Notes and any other guaranteed indebtedness hereafter incurred by the Company as permitted by clause (b) of Section 4.3 of the Loan Agreement (the Notes and any such other guaranteed indebtedness being herein called "Guaranteed Indebtedness") as follows:

Upon any distribution of assets of the Company upon any dissolution, winding up, liquidation or reorganization of the Company, whether in bankruptcy, insolvency or receivership proceedings or upon an assignment for the benefit of creditors or any other marshalling of the assets and liabilities of the Company or otherwise,

(a) the holders of Guaranteed Indebtedness shall first be entitled to receive payment in full of the principal thereof and the interest due thereon before the Guarantors or other members of the Company (herein-

after collectively called the "members of the Company") are entitled to receive any payment upon the principal of or interest on any indebtedness from the Company to them; and

(b) any payment or distribution of assets of the Company of any kind or character, whether in cash, property or securities to which the members of the Company would be entitled except for these provisions shall be paid by the trustee or agent or other person making such payment or distribution (or by the members of the Company if received by them) direct to the holders of Guaranteed Indebtedness or their representative or representatives ratably according to the aggregate amounts remaining unpaid on account of the principal of and interest on Guaranteed Indebtedness held or represented by each, to the extent necessary to make payment in full of all Guaranteed Indebtedness remaining unpaid, after giving effect to any concurrent payment or distribution to the holders of Guaranteed Indebtedness.

Nothing contained herein is intended to or shall impair, as between the Company, its creditors other than the holders of Guaranteed Indebtedness and the members of the Company the obligation of the Company, which is unconditional and absolute, to pay to such members the principal of and interest on any indebtedness from the Company to them as and when the same shall become due and payable in accordance with its terms, or to affect the relative rights of the members and creditors of the Company other than the holders of Guaranteed Indebtedness, nor shall anything herein prevent any member from exercising all

remedies otherwise permitted by applicable law upon default in the payment of any indebtedness of the Company to it, subject to the rights, if any, under these provisions of the holders of Guaranteed Indebtedness in respect of cash, property or securities of the Company received upon the exercise of any such remedy.

FIFTH: Paragraphs First to Fourth of this agreement are made by each Guarantor for the benefit of each of the Banks, the Agent and the several holders from time to time of

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the Notes and of any other Guaranteed Indebtedness of the Company, and may be enforced directly by the holders of the Notes and such other Guaranteed Indebtedness or by any of them, from time to time, as often as occasion may arise, or by the Agent for the benefit of the holders of the Notes. The Agent, however, shall not be under any obligation to take any action for the enforcement of this agreement or of the guaranty of any Guarantor hereunder, unless requested to take such action by a writing signed by or on behalf of the holders of not less than 25% in principal amount of the Notes then outstanding and tendered reasonable indemnity against the expenses and liabilities which it may incur in connection with or by reason of such action.

SIXTH: The Agent shall not be responsible for the recitals herein. The Agent shall not be accountable in respect of the form, validity or enforceability of this agreement, or of any of the provisions hereof, nor of the several

guaranties of the Guarantors hereunder, and it makes no representation with respect thereto. All rights of action under this agreement or under the said guaranties may be enforced by the Agent without the possession of any of the Notes, or the production thereof on the trial or other proceedings relative thereto.

SEVENTH: It is an express condition of each of the several guaranties provided for in this agreement that no recourse whatsoever shall be had under said guaranty against any stockholder, officer, director or employee as such of any Guarantor, or of any successor corporation, either at law or in equity, and whether by the enforcement of any assessment or penalty or by virtue of any statute, constitution or rule of law, or otherwise. All such rights and claims are expressly waived and released as a condition of and in consideration for the execution of this agreement and of said legend endorsed on the Notes.

EIGHTH: All covenants and agreements herein contained shall bind and inure to the benefit of the successors of the parties hereto respectively, and any successor Agent duly acting as such under the terms of the Loan Agreement or any trustee acting under any indenture pursuant to which Notes have been issued shall be deemed to be a successor of the Agent under the provisions of this agreement.

NINTH: This agreement shall be deemed to be a contract made under and shall be construed in accordance with and governed by the laws of the State of New York. Neither this agreement nor any provision hereof may be changed, waived, discharged or terminated orally but only

by an instrument in writing signed by the party against which enforcement of the change, waiver, discharge or termination is sought.

In Witness Whereof the parties hereto have executed this agreement as of the day and year above set forth.

Central Hudson Gas & Electric Corporation

By Ernest N. Acker
President

The Cincinnati Gas & Electric Company

By Walter (Illegible)
President

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Columbus and Southern Ohio Electric Company

By H. M. Miller
President

Consumers Power Company

By D. E. Karn
President

Delaware Power & Light Company

By H. H. Placek
President

The Detroit Edison Company

By Walker L. Cisler
President

IOWA-ILLINOIS GAS AND ELECTRIC COMPANY

By CHARLES H. WHIOMNY
President

LONG ISLAND LIGHTING COMPANY

By R. G. OLMSTED
Vice President

PHILADELPHIA ELECTRIC COMPANY

By R. G. RINCLIFFE,
President

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POTOMAC ELECTRIC POWER COMPANY

By R. ROY DUNN
President

ROCHESTER GAS AND ELECTRIC CORPORATION

By R. E. GUNNA
President

THE SOUTHERN COMPANY

By (Illegible) BAUCH, JR.
President

WISCONSIN ELECTRIC POWER COMPANY

By G. W. VAN DERZEE
Chairman of the Board

J. P. Morgan & Co. Incorporated
As Trustee of various pension trusts

By L. S. Haskins
Vice President

Bankers Trust Company
As Trustee of various pension trusts

By C. Wadsworth Farnum
Vice President

The Chase Manhattan Bank
As Trustee of various pension trusts

By James J. O'Brien
Vice President

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The First National City Bank of New York
As Trustee of various pension trusts

By H. B. McAdams
Vice President

City Bank Farmers Trust Company
As Trustee of various pension trusts

By H. B. McAdams
Vice President

BANKERS TRUST COMPANY
As Trusteee under agreement with American Brake Shoe Company dated May 17, 1940

By C. WADSWORTH FARNUM
Vice President

J. P. MORGAN & CO. INCORPORATED
As Agent

By JOHN M. MEYER, JR.
Sr. Vice President

POWER REACTOR DEVELOPMENT COMPANY

By ERNEST R. ACKER
Vice President

APPLICATION EXHIBIT XLI-A

Reference Line In Exhibit XI Schedule No. 1	Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	Reference Authority
Line 7.	CORE PROCESSING COSTS											
	Aqueous processing											
	Process throughput, kg/yr	1,955	2,735	2,670	3,199	2,681	2,814	2,648	2,800	3,021	2,997	
	Cost is derived from a charge of $102.00 per kg.	200	280	273	327	275	289	272	287	310	310	
	Clean-up Time 4 days at $15,300 per day	61	61	61	61	61	61	61	61	61	61	
	Convert U Salts to Metal											
	Cost is derived from a charge of $35 for UNH conversion to UF_6 and $70 for UF_6 conversion to metal per KG of throughput.	205	288	281	337	283	297	280	296	319	315	
	Convert PU Salts to Metal											
	Core PU production, kg/yr	8.85	15.75	21.98	27.45	28.87	39.26	36.82	36.66	42.03	42.18	
	Cost is derived from a charge of $1500 per kg of core PU production	13	24	33	41	43	59	55	55	63	63	Throughput Quantities by APDA, W. N. McDaniels. (Exhibit XLIX)
	Scrap Recovery Costs											
	Uranium returned to AEC as scrap	717	657	997	821	778	931	673	821	986	843	Process Costs derived from Chicago Operations Office, USAEC, Teletype Feb. 25, 1957
	Cost is derived from a charge of $67.50 per kg based on 20 per cent of uranium required from AEC	48	44	67	55	52	63	45	55	67	57	
Line 7.	Total, Core Processing Costs	527	697	715	821	714	769	713	754	820	810	
Line 8.	BLANKET PROCESSING COSTS											
	Aqueous processing											
	Process throughput, kg/yr	4,206	12,389	18,252	20,995	50,335	27,289	25,630	28,107	32,370	54,242	
	Cost is derived from a charge of $15.30 per kg of throughput.	64	190	279	321	770	417	392	430	495	830	Throughput Quantities by APDA, W. N. McDaniels.
	Clean-up Time 4 days at $15,300 per day	61	61	61	61	61	61	61	61	61	61	
	Convert PU Salts to Metal											
	Blanket PU production, kg/yr	6.01	28.68	48.76	60.65	119.13	83.11	78.62	86.46	114.55	159.97	
	Cost is derived from a charge of $1500 per kg of Blanket PU Production.	9	43	73	91	179	125	118	130	172	240	Process Costs derived from Chicago Operations Office USAEC, Teletype February 25, 1957.
	Storage Drum Cost	1	1	1	1	1	1	1	1	1	1	
Line 8.	Total, Blanket Processing	135	295	414	474	1011	604	572	622	729	1132	

Exhibit XLLa
Sheet 2

Reference Line in Exhibit XL Schedule No. 1	Year:	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	Reference Authority
Line 9	ADDITIONAL FUEL CYCLE COSTS											
	Core Shipping											
	Cost is derived from a charge of $20 per kg of core process throughput	39	55	54	64	54	57	52	56	60	60	APDA, J. Hanna
	Blanket Shipping											
	Cost is derived from a charge of $1 per kg of blanket process throughput	4	12	18	21	50	27	26	28	32	54	APDA, J. Hanna
	Core Fabrication											
	Core elements fabricated per yr.	131	120	182	150	142	170	123	150	180	154	APDA, J. Hanna
	Cost is derived from a charge of $2000 per element including axial blanket	262	240	364	300	284	340	246	300	360	308	APDA, J. Hanna
	Blanket Fabrication											
	Blanket elements fabricated per yr.	96	164	276	602	308	324	356	372	722	328	APDA, J. Hanna
	Cost is derived from a charge of $600 per element	58	98	122	139	395	197	185	204	238	424	APDA, J. Hanna
	Core Material Replacement											
	U 235 destroyed, kg per yr.	27.6	48.8	68.5	85.6	89.5	123.9	114.9	121.1	131.5	132.2	
	Cost is derived from a charge of $16.40 per kg gram of U 235 destroyed	452	801	1,122	1,404	1,469	2,032	1,884	1,985	2,158	2,167	AEC
	Blanket Material Replacement											
	Depleted U replacement, kg per yr.	10,416	14,919	24,555	46,716	25,709	27,616	28,576	30,455	56,031	27,455	APDA, J. Hanna
	Cost is derived from a charge of $2.60 per kg of depleted U replacement	27	39	64	121	67	72	74	79	146	71	AEC
	Control Poison Replacement											
	Estimated Cost	2	2	4	4	4	5	4	5	5	5	APDA, J. Hanna
	Special Material Rental											
	Kg of depleted U on int. on inventory valued at $2.60 per kg					60,406	60,290	63,157	65,419	88,966	62,020	
						6	6	7	7	9	7	
	Kg of core uranium inventory on interest on inventory valued at $4,419.20 per kg					3,588	3,960	3,588	3,588	3,942	3,785	APDA, J. Hanna
						634	700	634	634	697	669	
Line 9	Total, additional fuel cycle costs	844	1,247	1,748	2,053	2,963	3,436	3,112	3,298	3,705	3,765	

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Letter from H. L. Price, August 4, 1956

UNITED STATES
ATOMIC ENERGY COMMISSION
Washington 25, D. C.

Aug 4 1956

Power Reactor Development Company
1911 First Street
Detroit 26, Michigan

Gentlemen:

Enclosed is a construction permit issued by the Atomic Energy Commission authorizing Power Reactor Development Company to construct the utilization facility described therein.

The issuance of this permit is based on the information and representations contained in your original application filed on January 7, 1956, and amendments thereto filed on June 6, 1956, July 12, 1956, July 20, 1956, and July 23, 1956, including PRDC's program for carrying out further investigations and experiments leading to the final design of the proposed reactor.

As specified in the construction permit, prior to taking action on the conversion of the construction permit to a license to operate the facility, a final Hazards Summary Report must be submitted to AEC for evaluation and a determination that the reactor can, in fact, be operated without undue risk to the health and safety of the public.

As stated in the construction permit the Commission believes that the safety problems associated with the reactor will prove to be of a kind which can be resolved within a reasonable time. The Commission regards the fast breeder program as a very important program and will use its best efforts to assist the company to resolve these problems as completely and as quickly as possible. However, the Commission wants it to be clearly understood that in issuing this construction permit the emphasis is on the fact that it is a conditional one and that the Commission can make no commitment to convert the permit to a license until it is satisfied on all safety matters.

Also, as you are aware, PRDC has not submitted to date sufficient information for the Commission to make a finding with respect to financial qualifications. Paragraph 3d of the permit contains a condition that its continued effectiveness will be dependent upon a showing

[6291]

within 12 months by PRDC that its financial resources are such as to enable the Commission to make the required finding, unless for good cause shown the Commission extends the time for submission of such data.

You will observe that the final paragraph of this permit establishes an allocation of 3,929 kilograms of continued U-235 for use in connection with the operation of this facility. This allocation represents the quantity of U-235 estimated to be required for burn-up and losses, plus inventory. You will also observe that shipments of U-235 by the Commission to PRDC in accordance with Schedule 1 of the Appendix to the permit will be conditioned upon

PRDC's return to the Commission of material substantially in accordance with schedule 2 of the Appendix. The issuance of this permit and the allocation of U-235 contained therein is not to be construed as a commitment by the Commission to supply the U-235 in any form except UF6.

The issuance of this permit does not constitute a commitment on the part of the Commission to provide transportation or processing services with respect to the spent fuel.

Pursuant to established Commission policy, the Commission will undertake to supply PRDC's Boron 10 requirements, under appropriate terms and conditions and within the limitations of available supply, until such time as Boron-10 is available from a commercial source of supply.

An allocation of source material in the form of depleted uranium is not being made at this time pending completion of a study of the classification of this material.

Please communicate with us in the event you have any questions concerning any of the provisions of the construction permit.

Sincerely yours,

/s/ H. L. PRICE,
H. L. PRICE,
Director, Division of Civilian Application.

Enclosure

[6292]

Construction Permit, August 4, 1956

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON 25, D. C.

Seal No. CPPR-4

CONSTRUCTION PERMIT

Power Reactor Development Company of Detroit, Michigan (hereinafter "PRDC") on January 7, 1956, filed its application for license under Section 104b of the Atomic Energy Act of 1954 (hereinafter "the Act") to construct and operate a nuclear reactor (hereinafter "the reactor"). Amendments to the application were filed on June 6, 1956, July 12, 1956, July 20, 1956 and July 23, 1956. The original application together with said amendments is hereinafter referred to as "the application".

In its application PRDC has presented information on the general design of the reactor and its program for carrying out further investigations leading to a final design of the reactor. Based on the information submitted by PRDC, the Atomic Energy Commission (hereinafter "the Commission") has found that:

A. The reactor will be a utilization facility as defined in the Commission's regulations contained in Title 10, Chapter 1, C. F. R., Part 50, "Licensing of Production and Utilization Facilities".

B. The reactor will be a utilization facility involved in the conduct of research and development activities leading to the demonstration of the practical value

of that type of facility for industrial or commercial purposes.

C. PRDC, Atomic Power Development Associates, Commonwealth Associates, Inc., and United Engineers and Constructors, Inc., are technically qualified to design and construct said reactor.

D. (1) There are identified areas of uncertainty regarding the hazards potential of fast neutron breeder reactors that must be investigated and resolved. From the current state of the technology applicable to such reactors it can reasonably be inferred that there may be other areas of uncertainty not yet identified and requiring investigation and resolution. Of primary importance among the identified areas of uncertainty are:

(a) Whether there exists in the PRDC reactor a positive component of the temperature coefficient similar to that exhibited in the Commission's experimental breeder reactor

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(EBR-I). The source of the positive component of the temperature coefficient exhibited by EBR-I (presently believed to be caused by dimensional distortion of the core structure) must be identified and its effect, if any, in the PRDC reactor must be eliminated.

(b) Whether there is a credible condition of meltdown and reassembly of the fuel of the PRDC reactor which could result in an explosion that would breach the gas-tight building surrounding the reactor. Further investigations must be carried out to establish that a credible condition of meltdown with consequent U-235 accumulation of critical dimensions cannot result in such an explosion.

(2) On the basis of information presently available, the Commission believes that the problems relating to the safety of operation of the PRDC reactor will prove to be of a kind that can be satisfactorily resolved within a reasonable time. There is some doubt whether they can be resolved in time to meet the schedule proposed by PRDC in its application and in may turn out that further investigations beyond the program of investigation outlined by PRDC in its application will be needed.

E. Although PRDC has submitted evidence of a commitment from certain banks for a loan of $15,000,000 and has described its plan for obtaining additional financing from its member companies, the evidence submitted to date does not justify a finding with respect to the financial qualifications of PRDC and accordingly the continued effectiveness of this permit will be conditioned upon a further showing in this regard as stated below.

Pursuant to the Atomic Energy Act of 1954 and Title 10, C. F. R., Chapter 1, Part 50, "Licensing of Production and

Utilization Facilities," the Commission hereby issues a conditional construction permit to PRDC to construct the reactor as a utilization facility. This permit shall be deemed to contain and be subject to the conditions specified in Sections 50.54 and 50.55 of said regulations; is subject to all applicable provisions of the Atomic Energy Act of 1954 and rules, regulations and orders of the Atomic Energy Commission now or hereafter in effect; and is subject to the conditions specified below:

A. The earliest date for the completion of the reactor is December 15, 1959. The latest date for completion of the reactor is December 15, 1960. The term

[6294]

"completion date" as used herein means the date on which construction of the reactor is completed except for the introduction of the fuel material.

B. The site proposed for the location of the reactor is the location known as Lagoona Beach, Monroe County, Michigan, specified in the application.

C. The general type of facility authorized for construction is a fast neutron breeder reactor, more fully described in Report APDA-108, designed to operate at 300,000 KW equivalent of thermal energy and furnish approximately 100,000 kilowatts of electrical energy, and which will use uranium enriched in the isotope uranium 235 as fuel.

D. Unless, within twelve months from the date of this construction permit, PRDC submits sufficient information relating to its financial resources to enable

the Commission to make a finding that the Company has adequate financial resources to meet the requirements of the law and the regulations, this permit shall expire; provided that the Commission may for good cause shown extend the time for the submission of such data:

The conversion of this permit to a license is subject to submittal by PRDC to the Commission (by amendment of the application) of the complete, final Hazards Summary Report (portions of which may be submitted and evaluated from time to time). The final Hazards Summary Report must show that the final design provides reasonable assurance to the satisfaction of the Commission that the health and safety of the public will not be endangered by operation of the reactor in accordance with the specified procedures.

Upon completion (as defined in Paragraph "A" above) of the construction of the facility in accordance with the terms and conditions of this permit, upon the filing of any additional information needed to bring the original application up to date, upon finding that the final design provides reasonable assurance that the health and safety of the public will not be endangered by operation of the reactor in accordance with the specified procedures, and upon finding that the facility authorized has been constructed in conformity with the application as amended and in conformity with the provisions of the Act and of the rules and regulations of the Commission, and in the absence of any good cause being shown to the Commission why the granting of a license would not be in accordance with the provisions of the Act, the Commission will issue

a Class 104 license to PRDC pursuant to Section 104b of the Act, which license shall expire twenty-five (25) years after the date of this construction permit.

[6295]

From time to time PRDC may submit to the Commission, in writing, reports upon the progress being made in experimental and developmental work. Following the submission of each such report the Commission will review the data included therein to determine whether the results of such work can be incorporated as technical specifications by appropriate amendment to this permit.

Pursuant to Section 50.60 of the regulations in Title 10, Chapter 1, C. F. R., Part 50, the Commission has allocated to PRDC, for use in connection with the operation of the reactor, 3,929 kilograms of uranium 235 contained in uranium at the isotopic ratios specified in PRDC's application for license. Shipments by the Commission to PRDC in accordance with Schedule 1 of the Appendix hereto will be conditioned upon PRDC's return to the Commission of material substantially in accordance with Schedule 2 of the Appendix.

FOR THE ATOMIC ENERGY COMMISSION
H. L. PRICE
Director
Division of Civilian Application

Attachment:
Appendix "A"

Date of Issuance: August 4, 1956

[6296]

APPENDIX "A" TO CONSTRUCTION PERMIT

SCHEDULE 1

Estimated Schedule of Transfers of Special Nuclear Material from the Commission to PRDC

Year of Transfer	*Kilograms of Contained U-235*
1958	607
1959	0
1960	607
1961	1819
1962	1819
1963	3032
1964	1819
1965	3031
1966	2426
1967	1819
1968	1819
1969	1819
1970	1819
1971	1212
1972	1819
1973	1819
1974	1212
1975	1819
1976	1819
1977	1819
1978	1212
1979	1819
1980	1819
Total for License Period	38,805

[6297]

APPENDIX "A" TO CONSTRUCTION PERMIT

SCHEDULE 2

Estimated Schedule of Transfers of Special Nuclear Material from PRDC to the Commission

Year of Transfer	*Kilograms of Contained U-235*		*Total*
	In Scrap	*In Spent Fuel*	
1958	122	0	122
1959	0	0	0
1960	122	0	0
1961	363	920	1283
1962	363	920	1283
1963	606	1839	2445
1964	363	2299	2662
1965	606	1362	1968
1966	485	2269	2754
1967	363	1792	2155
1968	363	1326	1689
1969	363	1309	1672
1970	363	1309	1672
1971	242	873	1115
1972	363	1309	1672
1973	363	1309	1672
1974	242	873	1115
1975	363	1309	1672
1976	363	1309	1672
1977	363	1309	1672
1978	242	873	1115
1979	363	1309	1672
1980	363	1309	1672
Total for License Period			34,876

Appendix "A"

[6298]

UAW Petition for Intervention

Before the
United States Atomic Energy Commission

in re

License Application of Power Reactor Development Company

AEC Docket No. F-16

PETITION FOR INTERVENTION AND REQUEST FOR FORMAL HEARING

Now come the International Union, United Automobile, Aircraft and Agricultural Implement Workers of America, affiliated with the American Federation of Labor-Congress of Industrial Organizations, hereinafter referred to as UAW, Walter P. Reuther, President and a member of said UAW, Emil Mazey, Secretary Treasurer and a member of said UAW, and Carlos Gastambide, President of Local 878, UAW, and a member of said UAW, hereinafter referred to as Intervenors, and file herewith their petition to intervene in these proceedings under the Commission's Rules of Practice, Section 2.705, Title 10, CFR, on behalf of themselves and on behalf of and as representatives of the members of said UAW similarly situated, on the following grounds to wit:

[6299]

I. Intervenors state that each of said individual Intervenors resides, works and owns property within an area of

approximately forty miles of Lagoona Beach, Monroe County, Michigan, and that said Intervenor Carlos Gastambide is a resident of Monroe, Michigan. Intervenors further state that said Intervenor UAW is an unincorporated labor association composed of in excess of 1,500,000 members with principal offices at Detroit, Michigan; that said UAW admits to membership employees employed in plants and shops engaged in the manufacture of parts and the assembly of those parts into farm, automobile, automotive-propelled products, aircraft and agricultural implements, including employees engaged in office work, sales, distribution and maintenance thereof; that Walter P. Reuther is the duly elected President of said UAW, that Emil Mazey is the duly elected Secretary-Treasurer of said UAW, and that Carlos Gastambide is the duly elected President of said Local 878, UAW; that said Local 878, UAW, is composed of in excess of 1,000 members who are employed and reside in the vicinity of Monroe, Michigan; that the members of said UAW similarly situated on whose behalf this action is brought constitute a class so numerous as to make it impractical to bring them all before the Atomic Energy Commission; that the Intervenors herein will fairly insure the adequate representation of all, and that there are common questions of law and fact affecting the rights of the Intervenors and said members of the UAW, and that common relief is sought.

[6300]

II. Intervenors further state that on or about August 4, 1956 the Atomic Energy Commission granted a "conditional" construction permit in these proceedings to the Power Reactor Development Company of Detroit, Michi-

gan, hereinafter referred to as PRDC, for the construction of a fast neutron-breeder reactor more fully described in Report ADDA-108, designed to operate at 300,000 kw. equivalent of thermal energy and furnish approximately 100,000 kilowatts of electrical energy and which will use uranium enriched in the isotope uranium 235 as fuel; that the location specified for the construction of the facility is Lagoona Beach, Monroe County, Michigan. The "conditional" construction permit also "allocated" to PRDC special nuclear material for operation of the reactor during the period of the license.

III. Intervenors further state that Lagoona Beach, Monroe County, Michigan, is located approximately thirty miles from the cities of Toledo, Ohio, and Detroit, Michigan, and approximately seven and one-half miles from the city of Monroe, Michigan; that Monroe, Michigan has a population in excess of 21,000; Detroit, Michigan has a population in excess of 1,849,000; and Toledo, Ohio has a population in excess of 303,500; that within the cities of Detroit, Toledo, Monroe and vicinity there is a large concentration of members of said UAW; that there are in excess of 30,000

[6301]

members in the city of Toledo, in excess of 260,000 members in the city of Detroit, and in excess of 4,000 members in the city of Monroe; that, in addition to the above-described areas the UAW has many other members dwelling within an area which would be subjected to the impact of an atomic catastrophe caused by said reactor.

IV. Intervenors further state that said members are employed in shops, factories and industrial establishments

within said areas and that said UAW, together with its Locals, has collective bargaining agreements with employers in said shops, factories and industrial establishments; that the UAW owns real estate and other property, including its international headquarters, in said areas in excess of two million dollars ($2,000,000), that UAW Local 12 operates a summer camp for boys and girls at Sand Lake, Michigan, within a radius of forty miles from Lagoona Beach, Michigan, that said members own real estate and other property in said areas in excess of five hundred million dollars ($500,000,000), and that the individual Intervenors own real estate and other property in said areas in excess of thirty thousand dollars ($30,000).

V. Intervenors further state that the action of the AEC in granting the conditional construction permit herein (1) is a violation of the provisions of the Atomic Energy Act of 1954, and the regulations pursuant thereto

[6302]

adopted by the Commission, as more specifically set forth below; and (2) will result in the construction of a reactor which, under present technological conditions, is inherently unsafe, and which will thereby create a hazard which will place the individual Intervenors, the members of UAW and their families, and the UAW in danger of an explosion or other incident having the following effects:

(a) It would imperil and destroy the health and lives of said individual Intervenors, members, and their families.

(b) It would imperil and destroy the homes and other property in which said individual Intervenors and members have substantial investments.

(c) It would imperil and destroy the real estate holdings and other property, including the international headquarters, of said UAW.

(d) It would imperil and destroy the establishments at which said members are employed, and would result in a deprivation of facilities within said cities wherein said members earn a livelihood.

(e) It would depress the value of real estate and other property owned by said individual Intervenors, by said members, and by said UAW, and would influence industry to leave said areas which might be affected by an atomic catastrophe.

[6303]

(f) It would imperil the status of collective bargaining and would destroy the property rights of said UAW and its members in collective bargaining agreements with employers in said areas.

(g) It would contaminate the water supply of the city of Monroe and would imperil the usability of said city as a port on Lake Erie.

VI. Intervenors further state that one of the principal functions of the UAW is to protect the health and safety of its members, particularly in their places of employment. In the performance of this function it seeks to obtain suitable provisions in collective bargaining agreements protecting the health and safety of covered employees. It engages in educational campaigns, providing its members with information essential to the protection of their health and safety. It seeks to obtain remedial legislation on local,

state and national levels, promoting the health and safety of its members and all workers.

VII. Intervenors further state that the UAW has collective bargaining agreements with several hundred employers within a hundred-mile radius of Monroe, Michigan. More than five hundred thousand of its members are employed under the terms and provisions of said agreements within the plants located in said area. The existence of these plants as well as the safety of the employees working therein under contracts are placed

[6304]

in jeopardy by the aforesaid action of the Commission. The value of these contracts will be seriously impaired if the PRDC reactor is built in this area without reasonable assurances of safety.

VIII. Intervenors further state that the statutory standard for issuance of construction permits is established by Section 185 of the Atomic Energy Act of 1954, which provides as follows:

> "Sec. 185. Construction Permits.—All applicants for licenses to construct or modify production or utilization facilities shall, *if the application is otherwise acceptable to the Commission*, be initially granted a construction permit. *The construction permit shall state the earliest and latest dates for the completion of the construction* or modification. *Unless the construction or modification of the facility is completed by the completion date, the construction permit shall expire, and all right thereunder be forfeited, unless*

upon good cause shown, the Commission extends the completion date. Upon the completion of the construction or modification of the facility, upon the filing of any additional information needed to bring the original application up to date, and upon finding that the facility authorized has been constructed and will operate in conformity with the application as amended and in conformity with the provisions of this Act and of the rules and regulations of the Commission, and in the absence of any good cause being shown to the Commission why the granting of a license would not be in accordance with the provisions of this Act, the Commission shall thereupon issue a license to the applicant. For all other purposes of this Act, a construction permit is deemed to be a 'license'." (Emphasis added.)

IX. Intervenors further state that the rules and regulations officially promulgated by the AEC establish the AEC's standards for implementing the statutory requirement that a construction permit shall

[6305]

be initially granted if the application is "otherwise acceptable to the Commission." Section 50.45, Title 10, CFR, provides as follows:

"Section 50.45 *Standards for Construction Permits*

An applicant for a license or an amendment of a license who proposes to construct or alter a production or utilization facility will be initially granted a construction permit, *if the application is in conformity*

with and acceptable under the criteria of Sections 50.31 through 50.38 and the standards of Sections 50.40 through 50.43." (Emphasis added.)

Intervenors allege, as hereinafter more fully set forth, that said PRDC's construction permit is not in conformity with and acceptable under the criteria of said Sections nor of the statutes made and provided.

X. Intervenors further state that Section 50.40 of the AEC's rules and regulations establishes standards which the application of PRDC must be "in consistency with and acceptable under." Section 50.40 provides:

"Section 50.40 *Common Standards*

In determining that a license will be issued to an applicant, the Commission will be guided by the following considerations:

(a) The processes to be performed, the operating procedures, the facility and equipment, the use of the facility, and other technical specifications, or the proposals in regard to any of the foregoing collectively *provide reasonable assurance that the applicant will comply with the regulations in this chapter, including the regulations in Part 20, and that the health and safety of the public will not be endangered.*

[6306]

(b) *The applicant is* technically and *financially qualified to engage in the proposed activities in accordance with the regulations in this chapter.*

(c) The issuance of a license to the applicant will not, in the opinion of the Commission, be inimical to

the common defense and security or to the health and safety of the public." (Emphasis added.)

XI. Intervenors further state that the AEC's rules and regulations, Section 50.35, Title 10, CFR, provide:

"Section 50.35 *Extended Time for Providing Technical Information*

Where, because of the nature of a proposed project, an applicant is not in a position to supply initially all of the technical information otherwise required to complete the application, she shall indicate the reason, the items or kinds of information omitted, and the approximate times when such data will be produced. *If the Commission is satisfied that it has information sufficient to provide reasonable assurance that a facility of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public* and that the omitted information will be supplied, it may process the application and issue a construction permit on a provisional basis without the omitted information subject to its later production and an evaluation by the Commission that the final design provides reasonable assurance that the health and safety of the public will not be endangered." (Emphasis added.)

XII. Intervenors further state that the AEC did not make the finding requisite to the grant of a construction permit on a provisional basis under the aforesaid Section 50.35, *i.e.*, that:

[6307]

". . . the Commission is satisfied that it has information sufficient to provide reasonable assurance that a facility of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public . . ."

The other construction permits issued to date on a provisional basis have included this finding.

XIII. Intervenors further state that the AEC has made findings, recited in the "conditional" construction permit issued to PRDC, which are inconsistent with and contrary to the finding of "reasonable assurance" required by said Section 50.35. The AEC has found that there are "identified areas of uncertainty" regarding the hazards potential of the type of reactor proposed by PRDC, and that "from the current state of the technology . . . it can reasonably be inferred that there may be other areas of uncertainty not yet identified."

XIV. Intervenors further state that the AEC acted illegally, contrary to the provisions of Section 185 of the Atomic Energy Act, and contrary to the provisions of its own rules and regulations interpreting and implementing Section 185, in issuing the "conditional" construction permit without making the required finding of "reasonable assurance."

XV. Intervenors further state that Section 185 of the Atomic Energy Act of 1954 (quoted in Paragraph VIII hereof), as implemented and interpreted by Section 50.40(b), Title 10, CFR (quoted in Paragraph X hereof),

requires as a condition of issuance of a construction permit that the AEC find that the applicant is "financially qualified to engage in the proposed activities" in accordance with AEC regulations.

XVI. Intervenors further state that Section 50.60(b) of the AEC's regulations provides that where an applicant for a facility license requests that special nuclear material be allocated for use in the facility at the time the construction permit is issued, as PRDC requested in this case, the:

> ". . . request should be accompanied by *at least* the following information:
>
> (1) The applicant's *financial qualifications to assume responsibility for payment of Commission charges for the materials, and to undertake and carry out the proposed use of special nuclear material for a reasonable period of time*; . . .." (Emphasis added.)

XVII. Intervenors further state that Section 50.60(c) provides that

> "(c) A request for the incorporation in a construction permit or license of provisions designating the amount of special material available for use by the facility *will be approved by the Commission if*: . . .
>
> (2) The *applicant appears to be financially qualified* to assume responsibility for the payment of Commission charges for the material and to undertake and carry out the proposed use of special nuclear material for a reasonable period of time; and . . .." (Emphasis added.)

XVIII. Intervenors further state that PRDC's license application included vague information as to its general financial qualifications; but

[6309]

PRDC failed to comply with said Section 50.60, Title 10, CFR, in that it did not submit information specifically relating to its financial qualifications to assume responsibility for payment of the AEC's charges for special nuclear material and to undertake and carry out the proposed use of the material for a reasonable time.

XIX. Intervenors further state that the AEC's regulations clearly require that a finding of financial qualification must be made *before* a construction permit is issued and *before* special nuclear material is allocated, and that there is no provision in the regulations for issuing a construction permit or allocating special nuclear material "conditional" upon subsequent submission of evidence as to financial qualifications. The AEC did not make the finding, required under Sections 50.45 (quoted in Paragraph IX hereof) and 50.40 (quoted in Paragraph X hereof), Title 10, CFR, as a prerequisite for issuance of a construction permit, that PRDC was "financially qualified to engage in the proposed activity" in accordance with AEC regulations. Nor did the AEC make the finding required under Section 50.60(c)(2) (quoted in Paragraph XVII hereof) that PRDC "appears to be financially qualified" to assume responsibility for payment of AEC charges for material and to undertake and carry out the proposed use of the material for a reasonable time. On the contrary,

the "conditional" construction permit issued to PRDC recites the AEC's finding that:

> ". . . the evidence submitted to date does not justify a finding with respect to the financial qualifications of PRDC."

[6310]

XX. Intervenors further state that the AEC acted illegally, contrary to the provisions of Section 185 of the Atomic Energy Act, and contrary to the provisions of its own rules and regulations interpreting and implementing Section 185, in issuing to PRDC a "conditional" construction permit and in including in the permit an allocation of special nuclear material without the aforesaid requisite findings of "financial qualification."

XXI. Intervenors further state that the license application filed by PRDC reveals that PRDC's financial qualification is dependent upon the United States Government's acceding to three conditions laid down by PRDC: (a) statutory exemption of PRDC and its member companies from the provisions of the Public Utility Holding Company Act; (b) a ruling by the Internal Revenue Service that contributions of members to PRDC are deductible for federal income tax purposes; and (c) provision for adequate insurance protection against liability for damage claims arising from a catastrophe caused by its reactor. None of these three conditions had been met at the time the "conditional" construction permit was issued. AEC's issuance of the "conditional" construction permit under these circumstances was arbitrary, unreasonable, an abuse of dis-

cretion, and a violation of the applicable provisions of the statute and regulations.

[6311]

XXII. Intervenors further state that one of the purposes of the Atomic Energy Act of 1954 is, as stated in Section 3(d) of said Act, to provide for:

> "a program to encourage widespread participation in the development and utilization of atomic energy for peaceful purposes *to the maximum extent consistent with the common defense and security and with the health and safety of the public.*" (Emphasis added.)

Numerous provisions of the Act impose an affirmative duty upon the AEC to administer and regulate atomic energy developments in a manner which will assure the health and safety of the public. Thus, Section 104(b) of the Act, the Section under which the PRDC reactor will ultimately be licensed, refers to the AEC's "obligation under this Act . . . to protect the health and safety of the public."

XXIII. Intervenors further state that the AEC has constituted the Advisory Committee on Reactor Safeguards, consisting at the present time of fourteen eminent scientists and engineers, to assist it in the discharge of its aforesaid "obligation" to protect the health and safety of the public. Said Committee ". . . reviews safety studies referred to it by the Commission staff and advises the Commission with regard to the hazards of proposed or existing reactor facilities and the adequacy of proposed reactor safety standards."

[6312]

XXIV. Intervenors further state that the AEC, in accordance with its policy of referring all applications for reactor licenses to the Advisory Committee for its review and recommendations, referred the PRDC application to said Committee. On June 6, 1956, the Advisory Committee submitted to the AEC its report on the PRDC reactor. The report has been suppressed by the AEC in violation of the provisions of Section 146(b) of the Atomic Energy Act and Section 2.790, Title 10, CFR. Nevertheless, a member of the AEC and members of the Joint Committee on Atomic Energy have publicly revealed excerpts from the Report which quote the Advisory Committee as finding "that there is insufficient information available at this time to give assurance that the PRDC can be operated at this site without public hazard;" that it is "doubtful" whether sufficient information to give assurance of safe operation of the reactor "will be available in time to give assurance of safe operation of this reactor unless the present fast reactor program of the AEC is amplified and accelerated;" and that even such an accelerated program might not yield sufficient results to permit safe operation of the reactor at the Lagoona Beach site on the time schedule proposed by PRDC.

XXV. Intervenors further state that the Atomic Energy Commission, by a vote of three to one (the majority position being represented by two laymen and one scientist) voted to issue the "conditional" construction

[6313]

permit in disregard of the findings of said Committee, and that this action was arbitrary, unreasonable, capri-

cious, and a violation of the Atomic Energy Act of 1954 and the AEC's rules and regulations!

XXVI. Intervenors further state that Section 185 of the Atomic Energy Act of 1954 (quoted in Paragraph VIII hereof) requires that a construction permit expire and all rights thereunder be forfeited if the facility is not completed by the latest date specified for completion in the license application, unless the AEC "upon good cause shown" extends the completion date. The AEC has incorporated in the "conditional" construction permit issued to PRDC the date submitted by PRDC, December 15, 1960, as the latest date for completion of the reactor, despite the AEC's finding that "there is some doubt" whether the safety problems can be resolved in time to meet the schedule proposed by PRDC. Similar doubts have been expressed in stronger form by the Advisory Committee on Reactor Safeguards, as described in Paragraph XXIV hereof. Issuance of the construction permit with the completion date of December 15, 1960, specified therein, despite these doubts, is in violation of Section 185 since it renders completely meaningless the statutory requirement that construction of reactors be completed within the time limitation specified in the construction permit.

[6314]

XXVII. Intervenors further state that Section 104(d) of the Atomic Energy Act of 1954 provides that:

> "'. . . no license may be issued to any person within the United States if, in the opinion of the Commission, the issuance of a license to such person would be inimical . . . to the health and safety of the public."

and that said Commission has an obligation under the Act to protect the health and safety of the public.

XXVIII. Intervenors further state that construction of a fast neutron-breeder reactor, "the most hazardous of all reactors," with its inherent characteristics of instability and hazard, at a site near metropolitan population centers, before such a reactor has been constructed, tested, and experimentally proven in less populated areas, is inimical to the health and safety of the public, and that the AEC violated said Section 104(d), and abused its discretionary authority thereunder, in issuing the "conditional" construction permit to PRDC for construction of a reactor at Lagoona Beach, and ignored its obligation to protect the health and safety of the public.

XXIX. Intervenors further state that the action of the AEC in granting a "conditional" construction permit to PRDC on August 4, 1956, was irresponsible, precipitous, in flagrant violation of the Atomic Energy Act of 1954 and rules and regulations promulgated by the AEC, and

[6315]

provides reasonable grounds for belief that a license to operate said facility when it is completed, with an expenditure of $45,000,000, will be issued without proper consideration of and regard for the health and safety of the public.

WHEREFORE, said Intervenors pray that the Atomic Energy Commission:

(1) grant their petition to intervene;

(2) order immediate suspension of the "conditional" construction permit issued to Power Reactor Development Company pending a final determination of the questions raised herein;

(3) set this matter for a formal hearing, in accordance with Part 2, Title 10, CFR, at the earliest possible date; and

(4) rescind and declare a nullity the "conditional" construction permit issued to said Company until such time as there has been full compliance with all pertinent provisions of the statute, rules, and regulations, and said Company has submitted information affording reasonable assurance that a reactor of the type contemplated can be built and operated at the site in question without undue risk to the health and safety of the public.

[6316]

.....,

HAROLD A. CRANEFIELD,
General Counsel, UAW-AFL-CIO,
8000 East Jefferson Avenue,
Detroit 14, Michigan.

.....,

BENJAMIN C. SIGAL,
1126 16th Street, N. W.,
Washington, D. C.

.....,

HAROLD P. GREEN,
1700 K Street, N. W.,
Washington, D. C.

.....,

LOWELL GOERLICH,
718 Jackson Place, N. W.,
Washington, D. C.
Attorneys for Intervenors.

The foregoing petition for intervention and request for formal hearing has been served upon the PRDC by mailing a true copy thereof, by Registered Mail, to the Power Reactor Development Company at 1100 Dime Building, Detroit 26, Michigan, this 31st day of August, 1956.

.....,

Attorney for Intervenors.

[6317]

IUE and Paperworkers Petition for Intervention

UNITED STATES OF AMERICA

BEFORE THE ATOMIC ENERGY COMMISSION

In the Matter of
LICENSE APPLICATION OF POWER REACTOR DEVELOPMENT COMPANY

AEC Docket No. F-16

PETITION FOR INTERVENTION AND REQUEST FOR FORMAL HEARING

Now come the International Union of Electrical, Radio and Machine Workers, affiliated with the American Federa-

tion of Labor and Congress of Labor Organizations, hereinafter referred to as IUE; James B. Carey, President and a member of IUE; Al Hartnett, Secretary-Treasurer and a member of IUE; James Douglas, President of IUE Local 945, and file herewith their petition to intervene in these proceedings for themselves and on behalf, and as representatives, of the members of IUE, and in support of their petition state:

1. IUE is an unincorporated labor association composed of more than 350,000 members, with principal offices in Washington, D. C. IUE admits to membership employees of manufacturers of electrical machinery, appliances and products, tools and dies, machine tools and allied products, including employees engaged in office work, distribution, installation, service, and repair of electrical machinery and equipment. James B. Carey is the duly elected president of IUE; Al Hartnett is the duly elected secretary of IUE; James Douglas is the duly elected President of IUE Local 945, situated in Detroit, Michigan. The members of IUE on whose behalf this petition is filed constitute a class so numerous as to make it impractical to bring them all before the Atomic Energy Commission, hereinafter referred to as AEC. Intervenors herein will fairly ensure the adequate representation of all; there are common questions of law and fact affecting the rights of Intervenors and members of IUE, and common relief is sought.

2. On or about August 4, 1956 the Atomic Energy Commission granted a "conditional" construction permit in these proceedings to the Power Reactor Development Company of Detroit, Michigan, hereinafter referred to as PRDC, for the construction of a fast neutron-breeder reactor more

fully described in Report ADDA-108, designed to operate at 300,000 kw. equivalent of thermal energy and furnish approximately 100,000 kilowatts of electrical energy and which will use uranium enriched in the isotope uranium 235 as fuel. The location specified for the construction of the

[6318]

facility in Lagoona Beach, Monroe County, Michigan. The "conditional" construction permit also "allocated" to PRDC special nuclear material for operation of the reactor during the period of the license. This reactor is hereinafter referred to as PRDC reactor.

3. Lagoona Beach, Monroe County, Michigan, is approximately 30 miles from the cities of Detroit, Michigan, and Toledo, Ohio, and approximately 7½ miles from the city of Monroe, Michigan. Detroit has a population in excess of 1,849,000; Toledo has a population in excess of 303,500, and Monroe has a population in excess of 21,000. Within a radius of 30 miles from Lagoona Beach, there is a substantial concentration of members of IUE, and in addition, IUE has many other members dwelling within areas which would be subject to the impact of a catastrophe which would be caused in the event the PRDC reactor exploded or otherwise went out of control.

4. The members of IUE, including Intervenor James Douglas, own real estate and other property in said areas valued in excess of $10,000,000.

5. IUE has collective bargaining agreements with scores of employers within a 100-mile radius of Lagoona Beach, Monroe County, Michigan. More than 50,000 of its mem-

bers are employed under the terms and provisions of said agreements within the plants located in said area.

6. One of the principal functions of IUE is to protect the health and safety of its members, particularly in their places of employment. In the performance of this function it seeks to obtain suitable provisions in collective bargaining agreements protecting the health and safety of covered employees. It engages in educational campaigns, providing its members with information essential to the protection of their health and safety. It seeks to obtain remedial legislation on local, state and national levels, promoting the health and safety of all workers.

7. The action of AEC in granting the "conditional" permit herein

a. violates the provisions of the Atomic Energy Act of 1954, and the regulations pursuant thereto adopted by AEC, as more specifically set forth below;

b. will result in the construction of a reactor which, under present technological conditions, is inherently unsafe, thereby creating a hazard which will place Intervenors and the members of IUE and their families in danger of an explosion or other incident having the following effects:

(1) It would imperil and destroy the health and lives of the members of IUE and their families;

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(2) It would imperil and destroy the homes and other property in which the Intervenors and members of IUE have substantial investments;

(3) It would imperil and destroy the establishments at which said members are employed thereby resulting in a deprivation of facilities wherein said members earn their livelihood;

(4) It would depress the value of real estate and other property owned by the Intervenors and members of IUE and would influence industry in which these members work to leave the areas which might be affected by an atomic catastrophe;

(5) It would imperil and destroy the property rights of IUE and its members in collective bargaining agreements with employers in said areas.

8. The statutory standard for issuance of construction permits is established by Section 185 of the Atomic Energy Act of 1954, which provides as follows:

"All applicants for licenses to construct or modify production or utilization facilities, shall, if the application is otherwise acceptable to the Commission, be initially granted a construction permit. The construction permit shall state the earliest and latest dates for the completion of the construction or modification. Unless the construction or modification of the facility is completed by the completion date, the construction permit shall expire, and all rights thereunder be forfeited, unless upon good cause shown, the Commission extends the completion date. Upon the completion of the construction or modification of the facility, upon the filing of any additional information needed to bring the original application up to date, and upon finding that the facility authorized has been constructed and

will operate in conformity with the application as amended and in conformity with the provisions of this chapter and of the rules and regulations of the Commission, and in the absence of any good cause being shown to the Commission why the granting of a license would not be in accordance with the provisions of this chapter, the Commission shall thereupon issue a license to the applicant. For all other purposes of this chapter, a construction permit is deemed to be a 'license'."

9. The rules and regulations officially promulgated by AEC establish AEC's standards for implementing the statutory requirement that a construction permit shall be initially granted if the application is "otherwise acceptable to the Commission." Section 50.45, Title 10, CFR, provides as follows:

"*Standards for Construction Permits*

An applicant for a license, or an amendment of a license, who proposes to construct or alter a production or utilization facility will be initially granted a construction permit, if the application is in conformity with and acceptable under the criteria of sections 50.31 through 50.38 and the standards of sections 50.40 through 50.43."

10. Section 50.40 of AEC's rules and regulations provides:

"*Common Standards*

In determining that a license will be issued to an applicant, the Commission will be guided by the following considerations:

(a) The processes to be performed, the operating procedures, the facility and equipment, use of the facility, and other technical specifications, or the proposals in regard to any of the foregoing collectively provide reasonable assurance that the applicant will comply with the regulations in this chapter, including the regulations in Part 20, and that the health and safety of the public will not be endangered.

(b) The applicant is technically and financially qualified to engage in the proposed activities in accordance with the regulations of this chapter.

(c) The issuance of a license to the applicant will not, in the opinion of the Commission, be inimical to the common defense and security or to the health and safety of the public."

11. AEC's rules and regulations, Section 50.35, Title 10, CFR, provide:

"*Extended Time for Providing Technical Information*

Where, because of the nature of a proposed project, an applicant is not in a position to supply initially all of the technical information otherwise required to complete the application, he shall indicate the reason, the items or kinds of information omitted, and the approximate times when such data will be produced. If the Commission is satisfied that it has information sufficient to provide reasonable assurance that a facility of the general type proposed can be constructed and operated at the proposed location without undue risk

to the health and safety of the public, and that the omitted information will be supplied, it may process the application and issue a construction permit on a provisional basis without the omitted information subject to its later production, and an evaluation by the Commission that the final design provides reasonable assurance that the health and safety of the public will not be endangered."

12. AEC did not make the finding requisite to the grant of a construction permit on a provisional basis under the aforesaid Section 50.355, *i.e.*, that:

> "* * * the Commission is satisfied that it has information sufficient to provide reasonable assurance that a facility of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public * * *"

The other construction permits issued to date on a provisional basis have included this finding.

13. AEC has made findings, recited in the "conditional" construction permit issued to PRDC, which are inconsistent with and contrary to the finding of "reasonable assurance" required by said Section 50.35. AEC has found that there are "identified areas of uncertainty" regarding the hazards potential of the type of reactor proposed by PRDC, and that "from the current state of the technology * * * it can reasonably be inferred that there may be other areas of uncertainty not yet identified."

14. AEC acted illegally, contrary to the provisions of Section 185 of the Atomic Energy Act, and contrary to the provisions of its own rules and regulations interpreting and

implementing Section 185, in issuing the "conditional" construction permit without making the required finding of "reasonable assurance."

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15. Section 185 of the Atomic Energy Act of 1954, quoted above, as implemented and interpreted by Section 50.40(b), Title 10, CFR quoted above, requires as a condition of issuance of a construction permit that the AEC find that the applicant is "financially qualified to engage in the proposed activities" in accordance with AEC regulations.

16. Section 50.60(b) of the AEC's regulations provides that where an applicant for a facility license requests that special nuclear material be allocated for use in the facility at the time the construction permit is issued, as PRDC requested in this case, the:

> "* * * request should be accompanied by *at least* the following information:
>
> (1) *The applicant's financial qualifications to assume responsibility for payment of Commission charges for the materials, and to undertake and carry out the proposed use of special nuclear material for a reasonable period of time*; * * *" (Emphasis added.)

17. Section 50.60(c) provides that:

> "(c) A request for the incorporation in a construction permit or license of provisions designating the amount of special material available for use by the facility *will be approved by the Commission if*: * * *

(2) *The applicant appears to be financially qualified* to assume responsibility for the payment of Commission charges for the material and to undertake and carry out the proposed use of special nuclear material for a reasonable period of time; and * * *" (Emphasis added.)

18. PRDC's license application included vague information as to its general financial qualifications, but PRDC failed to comply with said Section 50.60, Title 10, CFR, in that it did not submit information specifically relating to its financial qualifications to assume responsibility for payment of AEC's charges for special nuclear material and to undertake and carry out the proposed use of the material for a reasonable time.

19. AEC's regulations require that a finding of financial qualification must be made *before* a construction permit is issued and *before* special nuclear material is allocated. There is no provision in the regulations for issuing a construction permit or allocating special nuclear material "conditional" upon subsequent submission of evidence as to financial qualifications. AEC did not make the finding, required under Sections 50.45 and 50.40, Title 10, CFR, quoted above, as a prerequisite for issuance of a construction permit, that PRDC was "financially qualified to engage in the proposed activity" in accordance with AEC regulations. Nor did AEC make the finding required under Section 50.60(c)(2), quoted above, that PRDC "appears to be financially qualified" to assume responsibility for payment of

AEC charges for material and to undertake and carry out the proposed use of the material for a reasonable time. On the contrary, the "conditional" construction permit issued to PRDC recites AEC's finding that:

> ". . . the evidence submitted to date does not justify a finding with respect to the financial qualifications of PRDC."

20. AEC acted illegally, contrary to the provisions of Section 185 of the Atomic Energy Act, and contrary to the provisions of its own rules and regulations interpreting and implementing Section 185, in issuing to PRDC a "conditional" construction permit and in including in the permit an allocation of special nuclear material without the aforesaid requisite findings of "financial qualification."

21. The license application filed by PRDC reveals that PRDC's financial qualification is dependent upon the United States Government's acceding to three conditions laid down by PRDC: (a) statutory exemption of PRDC and its member companies from the provisions of the Public Utility Holding Company Act; (b) a ruling by the Internal Revenue Service that contributions of members to PRDC are deductible for federal income tax purposes; and (c) provision for adequate insurance protection against liability for damage claims arising from a catastrophe caused by its reactor. None of these three conditions had been met at the time the "conditional" construction permit was issued. AEC's issuance of the "conditional" construction permit under these circumstances was arbitrary, unreasonable, an abuse of discretion, and a violation of the applicable provisions of the statute and regulations.

22. One of the purposes of the Atomic Energy Act of 1954 is, as stated in Section 3(d) of said Act, to provide for:

> "a program to encourage widespread participation in the development and utilization of atomic energy for peaceful purposes *to the maximum extent consistent with the common defense and security and with the health and safety of the public.*". (Emphasis added.)

Numerous provisions of the Act impose an affirmative duty upon AEC to administer and regulate atomic energy developments in a manner which will assure the health and safety of the public. Thus, Section 104(b) of the Act, the Section under which the PRDC reactor will ultimately be licensed, refers to AEC's "obligation under this Act . . . to protect the health and safety of the public."

23. AEC has constituted the Advisory Committee on Reactor Safeguards, consisting at the present time of fourteen eminent scientists and engineers, to assist it in the discharge of its aforesaid obligation to protect the health and safety of the

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public. Said Committee ". . . reviews safety studies referred to it by the Commission staff and advises the Commission with regard to the hazards of proposed or existing reactor facilities and the adequacy of proposed reactor safety standards."

24. In accordance with its policy of referring all applications for reactor licenses to the Advisory Committee for its review and recommendations, AEC referred the PRDC application to said Committee. On June 6, 1956, the Ad-

visory Committee submitted to the AEC its report on the PRDC reactor. The report has been suppressed by AEC in violation of the provisions of Section 146(b) of the Atomic Energy Act and Section 2.790, Title 10, CFR. Nevertheless, a member of AEC and members of the Joint Committee on Atomic Energy have publicly revealed excerpts from the Report which quote the Advisory Committee as finding "that there is insufficient information available at this time to give assurance that the PRDC can be operated at this site without public hazard;" that it is "doubtful" whether sufficient information to give assurance of safe operation of the reactor "will be available in time to give assurance of safe operation of this reactor unless the present fast reactor program of AEC is amplified and accelerated;" and that even such an accelerated program might not yield sufficient results to permit safe operation of the reactor at the Lagoona Beach site on the time schedule proposed by PRDC.

25. By a vote of three to one (the majority position being represented by two laymen and one scientist), AEC voted to issue the "conditional" construction permit in disregard of the findings of said Committee, and this action was arbitrary, unreasonable, capricious, and a violation of the Atomic Energy Act of 1954 and AEC's rules and regulations.

26. Section 185 of the Atomic Energy Act of 1954, quoted above, requires that a construction permit expire and all rights thereunder be forfeited if the facility is not completed by the latest date specified for completion in the license application, unless AEC "upon good cause shown" extends the completion date. AEC has incorporated in

the "conditional" construction permit issued to PRDC the date submitted by PRDC, December 15, 1960, as the latest date for completion of the reactor, despite AEC's finding that "there is some doubt" whether the safety problems can be resolved in time to meet the schedule proposed by PRDC. Similar doubts have been expressed in stronger form by the Advisory Committee on Reactor Safeguards, as described above. Issuance of the construction permit with the completion date of December 15, 1960, specified therein, despite these doubts, is in violation of Section 185 since it renders completely meaningless the statutory requirement that construction of reactors be completed within the time limitation specified in the construction permit.

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27. Section 104(d) of the Atomic Energy Act of 1954 provides that:

> "... no license may be issued to any person within the United States if, in the opinion of the Commission, the issuance of a license to such person would be inimical ... to the health and safety of the public."

28. Construction of a fast neutron breeder reactor, "the most hazardous of all reactors," with its inherent characteristics of instability and hazard, at a site near metropolitan population centers, before such a reactor has been constructed, tested, and experimentally proven in less populated areas, is inimical to the health and safety of the public. In issuing a "conditional" construction permit to PRDC under such circumstances, AEC violated said Section 104(d), and abused its discretionary authority thereunder.

29. The action of AEC in granting a "conditional" construction permit to PRDC on August 4, 1956, was irresponsible, precipitous, in flagrant violation of the Atomic Energy Act of 1954 and rules and regulations promulgated by the AEC and provides reasonable grounds for belief that when said facility is completed, after an expenditure of $45,000,000, a license to operate will be issued without proper consideration of and regard for the health and safety of the public.

WHEREFORE, Intervenors pray that the Atomic Energy Commission:

(1) grant their petition to intervene;

(2) order immediate suspension of the "conditional" construction permit issued to Power Reactor Development Company pending a final determination of the questions raised herein;

(3) set this matter for a formal hearing, in accordance with Part 2, Title 10, CFR, at the earliest possible date; and

(4) rescind and declare a nullity the "conditional" construction permit issued to said Company until such time as there has been full compliance with all pertinent provisions of the statute, rules and regulations, and said Company has submitted information affording reasonable assurance that a reactor of the type contemplated can be built and operated at the site in question without undue risk to the health and safety of the public.

BENJAMIN C. SIGAL, General Counsel, IUE,
Attorney for Intervenors.

JAMES B. CAREY, AL HARTNETT,
JAMES DOUGLAS, and INTERNATIONAL
UNION OF ELECTRICAL, RADIO AND
MACHINE WORKERS, AFL-CIO,
1126 16th Street, N. W.,
Washington, D. C.

Dated: August 31, 1956.

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PROOF OF SERVICE

The foregoing Petition for Intervention and Request for Formal Hearing has been served upon the Power Reactor Development Company by mailing a true copy thereof, by Registered Mail, to the Power Reactor Development Company at 1100 Dime Building, Detroit 26, Michigan, this 31st day of August, 1956.

.....

Attorney for Intervenors

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BEFORE THE
UNITED STATES ATOMIC ENERGY COMMISSION

IN RE

LICENSE APPLICATION OF POWER REACTOR DEVELOPMENT COMPANY

AEC Docket No. F-16

PETITION FOR INTERVENTION AND REQUEST FOR FORMAL HEARING

Now comes the International Union, United Paperworkers of America, affiliated with the American Federa-

tion of Labor-Congress, of Industrial Organizations, hereinafter referred to as UPA, Harry Sayre, President and a member of said UPA, Frank Grasso, Secretary-Treasurer and a member of said UPA, Max Van Wickle, President of Local 999, UPA, and a member of said UPA, Joseph Stanifer, President of Local 1000, UPA, and a member of said UPA, Lawrence Helten, President of Local 1003, UPA, and a member of said UPA, John Jennings, President of Local 1004, UPA, and a member of said UPA, and Frank Meade, Jr., President of Local 1006, UPA, and a member of said UPA, hereinafter referred to as Intervenors and file herewith their petition to intervene in these proceedings under the Commission's Rules of Practice, Section 2.705, Title 10, CFR, on behalf of themselves and on behalf of and as representatives of the members of said UPA similarly situated, on the following grounds to wit:

I. Intervenors state that said individual intervenor's Max Van Wickle, Joseph Stanifer, Lawrence Helten, John Jennings, Frank Meade, Jr. and the members of said UPA similarly situated reside, work and own property within an area approximately 10 miles of Lagoona Beach, Monroe County, Michigan, and that said Intervenors are residents of Monroe, Michigan. Intervenors

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further state that said Intervenor UPA is an unincorporated labor association composed of in excess of 60,000 members with principal offices at Washington, D. C.: that said UPA admits to membership employees employed in plants and shops engaged in the manufacture of paper and related products; that Harry Sayre is the duly elected President of UPA, that Frank Grasso is the duly elected

Secretary-Treasurer of UPA and that Max Van Wickle, Joseph Stanifer, Lawrence Helton, John Jennings and Frank Meade, Jr. are the duly elected Presidents of Locals 999, 1000, 1003, 1004 and 1006 respectively; that said Local 999, UPA is composed of 147 members, that Local 1000 is composed of in excess of 550 members, that Local 1003 is composed of in excess of 200 members, that Local 1004 is composed of in excess of 700 members and that said Local 1006 is composed of in excess of 150 members, all of whom are employed and reside in the vicinity of Monroe, Michigan: that the members of the said UPA similarly situated on whose behalf this action is brought constitute a class so numerous as to make it impractical to bring them all before the Atomic Energy Commission: that the Intervenors herein will fairly insure the adequate representation of all, and that there are common questions of law and fact effecting the rights of the Intervenors and said members of the UPA and that common relief is sought.

II. Intervenors further state that on or about August 4, 1956, the Atomic Energy Commission granted a "conditional" construction permit in these proceedings to the Power Reactor Development Company of Detroit, Michigan, hereinafter referred to as PRDC, for the construction of a fast neutron-breeder reactor more fully described in Report ADDA-108, designed to operate at 300,000 kw. equivalent of thermal

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energy and furnish approximately 100,000 kilowatts of electrical energy and which will use uranium enriched in the isotope uranium 235 as fuel; that the location specified for the construction of the facility is Lagoona Beach, Mon-

roe County, Michigan. The "conditional" construction permit also "allocated" to PRDC special nuclear material for operation of the reactor during the period of the license.

III. Intervenors further state that Lagoona Beach, Monroe County, Michigan, is located approximately thirty miles from the city of Detroit, Michigan and approximately seven and one-half miles from the city of Monroe, Michigan: that Monroe, Michigan has a population in excess of 21,000; Detroit, Michigan has a population in excess of 1,849,000; that within the cities of Detroit and Monroe and vicinity there is a large concentration of members of said UPA; that there are in excess of 1,000 members in the vicinity of the city of Detroit, and in excess of 2,000 members in the city of Monroe; that, in addition to the above-described areas, the UPA has many other members dwelling within an area which would be subject to the impact of an atomic catastrophe caused by said reactor.

IV. Intervenors further state that said members are employed in shops, factories and industrial establishments within said areas and that said UPA, together with its Locals, has collective bargaining agreements with employers in said shops, factories and industrial establishments; that said members own real estate and other property in said areas in excess of seven million dollars ($7,000,000), and that the individual Intervenors own real estate and other property in said areas in excess of fifty thousand dollars ($50,000).

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V. Intervenors further state that the action of the AEC in granting the conditional construction permit herein (1)

is a violation of the provisions of the Atomic Energy Act of 1954, and the regulations pursuant thereto adopted by the Commission, as more specifically set forth below; and (2) will result in the construction of a reactor which, under present technological conditions, is inherently unsafe, and which will thereby create a hazard which will place the individual Intervenors, the members of UPA and their families, in danger of an explosion or other incidents having the following effects:

(a) It would imperil and destroy the health and lives of said individual Intervenors, members, and their families.

(b) It would imperil and destroy the homes and other property in which said individual Intervenors and members have substantial investments.

(c) It would imperil and destroy the establishment at which said members are employed, and would result in a deprivation of facilities within said cities wherein said members earn a livelihood.

(d) It would depress the value of real estate and other property owned by said individual Intervenors, by said members, which might be affected by an atomic catastrophe.

(e) It would imperil the status of collective bargaining and would destroy the property rights of said UPA and its members in collective bargaining agreements with employers in said areas.

(f) It would contaminate the water supply of the city of Monroe endangering the health of the citizens and disabling the paper industry through a destruction of its essential water resource.

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VI. Intervenors further state that one of the principal functions of the UPA is to protect the health and safety of its members, particularly in their places of employment. In the performance of this function it seeks to obtain suitable provisions in collective bargaining agreements protecting the health and safety of covered employees. It engages in educational campaigns, providing its members with information essential to the protection of their health and safety. It seeks to obtain remedial legislation on local, state and national levels, promoting the health and safety of its members and all workers.

VII. Intervenors further state that the UPA has collective bargaining agreements with approximately fifteen employers within a hundred mile radius of Monroe, Michigan. More than five thousand of its members are employed under the terms and provisions of said agreements within the plants located in said area. The existence of these plants as well as the safety of the employees working therein under contracts are placed in jeopardy by the aforesaid action of the Commission. The value of these contracts will be seriously impaired if the PRDC reactor is built in this area without reasonable assurances of safety.

VIII. Intervenors further state that the statutory standard for issuance of construction permits is established by Section 185 of the Atomic Energy Act of 1954, which provides as follows:

> "Sec. 185. Construction Permits.—All Applicants for licenses to construct or modify production or utilization facilities shall, *if the application is otherwise ac-*

ceptable to the Commission, be initially granted a construction permit. *The construction permit shall state the earliest and latest dates for the completion of the construction* or

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modification. *Unless the construction or modification of the facility is completed by the completion date, the construction permit shall expire, and all right thereunder be forfeited, unless upon good cause shown*, the Commission extends the completion date. Upon the completion of the construction or modification of the facility, upon the filing of any additional information needed to bring the original application up to date, and upon finding that the facility authorized has been constructed and will operate in conformity with the application as amended and in conformity with the provisions of this Act and of the rules and regulations of the Commission, and in the absence of any good cause being shown to the Commission why the granting of a license would not be in accordance with the provisions of this Act, the Commission shall thereupon issue a license to the applicant. For all other purposes of this Act, a construction permit is deemed to be 'license.' " (Emphasis added.)

IX. Intervenors further state that the rules and regulations officially promulgated by the AEC establish the AEC's standards for implementing the statutory requirement that a construction permit shall be initially granted if the application is "otherwise acceptable to the Commission." Section 50.45, Title 10, CFR, provides as follows:

"Section 50.45 *Standards for Construction Permits*

"An applicant for a license or an amendment of a license who proposes to construct or alter a production or utilization facility will be initially granted a construction per. *if the application is in conformity with and acceptable under the criteria of Sections 50.31 through 50.38 and the standards of Sections 50.40 through 50.43.*" (Emphasis added.)

Intervenors allege, as hereinafter more fully set forth, that said PRDC's construction permit is not in conformity with and acceptable under the criteria of said Sections nor of the statutes made and provided.

X. Intervenors further state that Section 50.40 of the AEC's rules and regulations establishes standards which the application of PRDC must be "in consistency with and acceptable under." Section 50.40 provides:

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"Section 50.40 *Common Standards*

"In determining that a license will be issued to an applicant, the Commission will be guided by the following considerations:

(a) The processes to be performed, the operating procedures, the facility and equipment, the use of the facility, and other technical specifications, or the proposals in regard to any of the foregoing collectively *provide reasonable assurance that the applicant will comply with the regulations in this chapter, including the regulations in Part 20, and that the health and safety of the public will not be endangered.*

(b) The issuance of a license to the applicant will not, in the opinion of the Commission, be inimical to the common defense and security or to the health and safety of the public." (Emphasis added.)

XI. Intervenors further state that the AEC's rules and regulations, Section 50.35, Title 10, provide:

"Section 50.35 *Extended Time for Providing Technical Information*

"Where, because of the nature of a proposed project, an applicant is not in a position to supply initially all of the technical information otherwise required to complete the application, he shall indicate the reason, the items or kinds of information omitted, and the approximate times when such data will be produced. *If the Commission is satisfied that it has information sufficient to provide reasonable assurance that a facility of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public* and that the omitted information will be supplied it may process the application and issue a construction permit on a provisional basis without the omitted information subject to its later production and an evaluation by the Commission that the final design provides reasonable assurance that the health and safety of the public will not be endangered." (Emphasis added.)

XII. Intervenors further state that the AEC did not make the finding requisite to the grant of a construction permit on a provisional basis under the aforesaid Section 50.35, *i.e.*, that:

". . . the Commission is satisfied that it has information sufficient to provide reasonable assurance that a facility of the general type proposed can be constructed and operated at the proposed location

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without undue risk to the health and safety of the public . . ."

The other construction permits issued to date on a provisional basis have included this finding.

XIII. Intervenors further state that the AEC has made findings, recited in the "conditional" construction permit issued to PRDC, which are inconsistent with and contrary to the finding of "reasonable assurance" required by said Section 50.35. The AEC has found that there are "identified areas of uncertainty" regarding the hazards potential of the type of reactor proposed by PRDC, and that "from the current state of the technology . . . it can reasonably be inferred that there may be other areas of uncertainty not yet identified."

XIV. Intervenors further state that the AEC acted illegally, contrary to the provisions of Section 185 of the Atomic Energy Act, and contrary to the provisions of its own rules and regulations interpreting and implementing Section 185, in issuing the "conditional" construction permit without making the required finding of "reasonable assurance."

XV. Intervenors further state that one of the purposes of the Atomic Energy Act of 1954 is, as stated in Section 3 (d) of said Act, to provide for:

"a program to encourage widespread participation in the development and utilization of atomic energy for peaceful purposes to the maximum extent consistent with the common defense and security and with the health and safety of the public."

Numerous provisions of the Act impose an affirmative duty upon the AEC to administer and regulate atomic energy developments in a manner which will assure the health and safety of the public. Thus, Section 104 (b) of the Act, the Section under which the PRDC reactor will ultimately be licensed, refers to the AEC's "obligation under this Act . . . to protect the health and safety of the public."

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XVI. Intervenors further state that the AEC has constituted the Advisory Committee on Reactor Safeguards, consisting at the present time of fourteen eminent scientists and engineers, to assist it in the discharge of its aforesaid "obligation" to protect the health and safety of the public. Said Committee ". . . reviews safety studies referred to it by the Commission staff and advises the Commission with regard to the hazards of proposed or existing reactor facilities and the adequacy of proposed reactor safety standards.

XVII. Intervenors further state that the AEC, in accordance with its policy of referring all applications for reactor licenses to the Advisory Committee for its review and recommendations, referred the PRDC application to said Committee. On June 6, 1956, the Advisory Committee submitted to the AEC its report on the PRDC reactor. The report has been suppressed by the AEC in violation of the provisions of Section 146 (b) of the Atomic Energy

Act and Section 2.790, Title 10, CFR. Nevertheless, a member of the AEC and members of the Joint Committee on Atomic Energy have publicly revealed excerpts from the Report which quote the Advisory Committee as finding "that there is insufficient information available at this time to give assurance that the PRDC can be operated at this site without public hazard; "that it is doubtful" whether sufficient information to give assurance of safe operation of the reactor "will be available in time to give assurance of safe operation of this reactor unless the present fast reactor program of the AEC is amplified and accelerated;" and that even such an accelerated program might not yield sufficient results to permit safe operation of the reactor at the Lagoona Beach site on the time schedule proposed by PRDC.

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XVIII. Intervenors further state that Section 104 (d) of the Atomic Energy Act of 1954 provides that:

> ". . . no license may be issued to any person within the United States if, in the opinion of the Commission, the issuance of a license to such person would be inimical . . . to the health and safety of the public."

and that said Commission has an obligation under the Act to protect the health and safety of the public.

XIX. Intervenors further state that the action of the AEC in a "conditional" construction permit to PRDC on August 4, 1956, was in violation of the Atomic Energy Act of 1954 and rules and regulations promulgated by the AEC, and provides reasonable grounds for belief that a license to operate said facility when it is completed, with an ex-

penditure of $45,000,000, will be issued without proper consideration of and regard for the health and safety of the public.

WHEREFORE, said Intervenors pray that the Atomic Energy Commission:

(1) grant their petition to intervene

(2) order immediate suspension of the "conditional" construction permit issued to Power Reactor Development Company pending a final determination of the questions raised herein;

(3) set this matter for a formal hearing, in accordance with Part 2, Title 10, CFR, at the earliest possible date, and

(4) rescind and declare a nullity the "conditional" construction permit issued to said Company until such time as there has been full compliance with all pertinent provisions of the statute, rules, and regulation, and said Company has submitted information affording reasonable assurance that a reactor of the type contemplated can be built and operated at

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the site in question without undue risk to the health and safety of the public.

HARRY SAYRE,
International President United Paperworkers of America, AFL-CIO
1029 Vermont Ave., N.W., Wash., D.C.

FRANK GRASSO,
International Sec.-Treas, United Paperworkers of America, AFL-CIO
1029 Vermont Ave., N.W., Wash., D.C.

MAX VAN WICKLE,
President, Local 999, UPA
13660 Dunlap Rd., LaSalle, Michigan

JOSEPH STANIFER,
President, Local 1000, UPA
509 East 2nd St., Monroe, Michigan

LAWRENCE HELTEN,
Pres., Local 1003, UPA
827 Winston Drive, Monroe, Mich.

JOHN JENNINGS,
Pres., Local 1004, UPA
706 E. 1st St., Monroe, Mich.

FRANK MEADE, JR.,
Pres., Local 1006, UPA
220 West Elm Ave., Monroe, Mich.

The foregoing petition for intervention and request for formal hearing has been served upon the PRDC by mailing a true copy thereof, by Registered Mail, to the Power Reactor Development Company at 1100 Dime Building Detroit 26, Michigan, this 31st day of August, 1956.

HARRY SAYRE,
International President
UPA-AFL-CIO

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PRDC Answer to UAW Petition

UNITED STATES OF AMERICA
ATOMIC ENERGY COMMISSION

In The Matter Of
POWER REACTOR DEVELOPMENT COMPANY

Docket No. F-16

ANSWER TO PETITION OF INTERNATIONAL UNION, UNITED PAPERWORKERS OF AMERICA, AFL-CIO, HARRY SAYRE, FRANK GRASSO, MAX VAN WICKLE, JOSEPH STANIFER, LAWRENCE HELTEN, JOHN JENNINGS AND FRANK MEADE, JR., INSOFAR AS SAID PETITION RELATES TO A REQUEST FOR LEAVE TO INTERVENE AND FOR SUSPENSION OF THE CONSTRUCTION PERMIT ISSUED TO POWER REACTOR DEVELOPMENT COMPANY ON AUGUST 4, 1956

and

MOTION TO STRIKE

NOW COMES Power Reactor Development Company, a non-profit corporation organized and existing under and by virtue of the laws of the State of Michigan, Applicant herein, and for answer to the Petition referred to above, insofar as the said Petition requests leave to intervene in these proceedings and insofar as said Petition requests

suspension of the Construction Permit issued Applicant on August 4, 1956, says as follows:

1. Applicant is unable to find warrant for intervention by these Petitioners in these proceedings in either the Atomic Energy Act of 1954, as amended, or in the Regulations promulgated thereunder, but Applicant is willing to leave the determination of the right of Petitioners to intervene to the decision of the Commission.

2. The Applicant is willing at any time in a proper hearing to present evidence on the merits and submit to the Commissioner the

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determination of Applicant's right to retain the Construction Permit which has been hitherto issued to Applicant.

3. The prayer of said Petition that the Construction Permit issued to Applicant be suspended pending the final determination of questions raised by the Petition to Intervene should be denied for the following reasons:

a) The grant of such prayer would be tantamount to granting the relief requested by the Petition, *i.e.*, the revocation of the Construction Permit without a prior hearing.

b) The grant of such request would unreasonably delay Applicant in proceeding with essential research and other plans for the construction of the reactor plant and would interfere with the policy of the United States in expediting the development of atomic energy for peaceful purposes.

c) Refusal to grant such request can have no conceivable effect upon the health or safety of the public as

the activities in which Applicant is presently engaged under the authority of the Construction Permit are related solely to preparation of the construction site, design and procurement of mechanical components of the proposed reactor plant and continued research. No fissionable materials are employed by Applicant at the construction site, and none will be so employed until Applicant is granted a license to operate the reactor plant, which will not be earlier than December 1, 1959. Therefore, the present activities of the Applicant cannot possibly create hazard to the health or safety of the public.

d) The Atomic Energy Commission issued the Construction Permit to Applicant after full consideration of the Application for License submitted by Applicant, and no showing is made by the Petition for Intervention which would warrant suspension or revocation of the said

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Construction Permit without a prior hearing, and the action of the Atomic Energy Commission in issuing the said Construction Permit must be deemed proper until and unless a showing is made in open hearing to the contrary.

e) The grant of such request would be contrary to the provisions of Section 2.200 *et seq.*, Title 10, C.F.R., of the Regulations promulgated by the Atomic Energy Commission, which provide the procedure to be followed in connection with the revocation, suspension, modification and amendment of licenses and construction permits and which provide that the permit holder be given an opportunity to demonstrate or achieve compliance with require-

ments of the Atomic Energy Commission where conditions or conduct are claimed to exist which, if they did exist, would warrant revocation, suspension, modification or amendment of a license or permit, and which provide further that the Atomic Energy Commission shall give notice prior to the institution of any proceeding for the revocation, suspension, modification or amendment of a permit. The Commission has established a requirement that a hearing be had before a construction permit can be suspended, and no showing has been made by Petitioners that any emergency action within the contemplation of the Rules and Regulations of the Atomic Energy Commission is required.

4. Applicant denies that the reactor plant proposed by Applicant would cause any atomic catastrophe or create any hazard which would place any of the Intervenors in danger of explosion or other incident which would imperil health, life or property. Applicant asserts that the Atomic Energy Commission has in all respects acted properly within its authority and in the interest of the health and safety of the public in connection with these proceedings.

5. Applicant hereby moves the Atomic Energy Commission

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to order that all reference to suppression of the report of the Advisory Committee on Reactor Safeguards be stricken from the Petition. The Advisory Committee on Reactor Safeguards is not created by statute, nor is it created by the Atomic Energy Commission as a separate Advisory Board pursuant to any statutory authority, and reference

to the said report or the internal method of handling the same within the Commission is not relevant to these proceedings.

WHEREFORE, Applicant prays that the Atomic Energy Commission

1. Determine whether or not Intervenors have a right to intervene in these proceedings.

2. That if such determination is made favorable to Intervenors, a hearing officer be promptly appointed and this matter be promptly set for formal hearing upon those matters properly raised by the Petition to Intervene and Applicant be given an opportunity to fully answer each allegation made in the said Petition.

3. Deny the request of the Petition to Intervene that the Construction Permit be suspended pending determination of the questions raised by the said Petition.

4. Order all reference to "suppression" of the report of the Advisory Committee on Reactor Safeguards stricken from the said Petition.

MILLER, CANFIELD, PADDOCK AND STONE

By EDWARD S. REID, JR.
Edward S. Reid, Jr.

And RICHARD B. GUSHEE
Richard B. Gushee
Attorneys for Power Reactor Development Company
3456 Penobscot Building
Detroit 26, Michigan
Woodward 3-6420

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Notice of Hearing, Order and Memorandum, October 8, 1956

UNITED STATES OF AMERICA

ATOMIC ENERGY COMMISSION

In the Matter of

POWER REACTOR DEVELOPMENT COMPANY.

Docket No. F-16.

Notice of Hearing, Order and Memorandum.

At a session of the Atomic Energy Commission held in Washington, D. C., on the 8th of October, 1956, Chairman Lewis L. Strauss and Commissioners Willard F. Libby, Thomas E. Murray, and Harold S. Vance present, it appeared that:

On January 7, 1956, Power Reactor Development Company (hereinafter called "the applicant") filed its application for a construction permit, under Section 104b. of the Atomic Energy Act of 1954, to build a nuclear reactor. Amendments to the application were filed on June 6, July 12, July 20 and July 23, 1956. On August 4, 1956, the Commission issued a provisional construction permit (CPPR-4) under section 50.35 of its regulations (10 CFR 50.35) authorizing construction of said reactor subject to certain conditions.

Petitions for leave to intervene and further relief were filed on August 31, 1956, on behalf of the International

Union, United Automobile, Aircraft and Agricultural Implement Workers of America, AFL-CIO, Walter P. Reuther, Emil Mazey and Carlos Gastambide; on behalf of the International Union of Electrical, Radio and Machine Workers, AFL-CIO, James B. Carey, Al Hartnett and James Douglas; and on behalf of the International Union, United Paperworkers of America, AFL-CIO, Harry Sayre, Frank Grasso, Max Van Wickle, Joseph Stanifer, Lawrence Helten, John Jennings, and Frank Meade, Jr.:

On September 14, 1956, the applicant filed answering papers to said petition insofar as they request leave to intervene and suspension of said construction permit pending a final determination of the

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matters raised by said petitions, and the applicant moved that the Commission strike certain statements from said petitions; and

On September 19 and 20, 1956, petitioners filed additional statements in opposition.

Upon due consideration of the foregoing, and in light of the considerations expressed in the annexed memoranda of the Commissioners,

It is Ordered That:

(1) The petitions for leave to intervene filed on behalf of the above named petitioners are granted and said interveners are made parties to the hearing ordered herein;

(2) Pursuant to Section 189 of the Atomic Energy Act of 1954 and the Commission's regulations, a hearing shall

be held on said application upon the following Specification of Issues:

A. 1. Whether there is information sufficient to provide reasonable assurance that a utilization facility of the general type proposed in the application can be constructed and operated at the location proposed therein without undue risk to the health and safety of the public.

2. Whether there is reasonable assurance that technical information omitted from and required to complete the application will be supplied.

B. Whether, pursuant to Section 50.40(b) of the Commission's regulations, the applicant is financially qualified to engage in the proposed activities; and whether, pursuant to Section 50.60(c)(2) of the Commission's regulations, the applicant is financially qualified to receive an allocation of special nuclear material.

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C. With respect to any matter in controversy in this proceeding, whether the Commission may, or should, grant any exemption pursuant to Section 50.12 of its regulations on the ground that such exemption is "authorized by law and will not endanger life or property or the common defense and security and . . . [is] otherwise in the public interest."

D. If the issues in the proceeding are resolved in favor of continuing the construction permit, what additional or different provisions, if any, should be incorporated in it.

(3) Jay A. Kyle, Esq., is designated as the presiding officer to conduct the hearing. The hearing shall commence on November 13, 1956, in Washington, D. C., at the offices of the Commission or on such adjourned date or at such other place as may be directed by the presiding officer. Pursuant to Section 2.751(b) of the Commissioner's regulations, the presiding officer at the conclusion of the hearing shall, without rendering an intermediate decision, certify the record of the hearing to the Commission.

(4) The interveners' requests for an immediate suspension of said construction permit pending the final determination of the matters raised by said petitions are denied without prejudice to ultimate determination by the Commission as to whether the permit should be continued, modified or vacated.

(5) On or before October 22, 1956, the applicant and the interveners shall file and serve their answers pursuant to Section 2.736 of the Commission's regulations.

(6) A copy of the letter dated June 6, 1956, from C. Rogers McCullough, Chairman, Advisory Committee on Reactor Safeguards, to the General Manager shall be sent to each of the interveners and placed in the Commission's public document room.

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(7) Papers required to be filed with AEC in this proceeding shall be filed with the Secretary, Atomic Energy Commission, 1901 Constitution Avenue, N. W., Washington 25, D. C. Pending further order of the presiding officer, the parties shall file ten copies of each such paper with

AEC and where service of papers is required on other parties shall serve five copies on each.

ATOMIC ENERGY COMMISSION

By WOODFORD B. MCCOOL
Secretary

Dated: October 8, 1956

(SEAL)

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MEMORANDUM OF THE COMMISSION

1. The provisional construction permit was issued on August 4, 1956. Attached hereto is a copy of the letter of August 4, 1956, to the Company forwarding the permit. On August 31, 1956, which was within 30 days thereof, the petitioners made their request for leave to intervene and for further relief.

2. The allegations of the petitioners purporting to show their interest in the proceeding are not controverted by the applicant. *Prima facie*, these allegations provide a basis for the granting of leave to intervene in the proceedings before the Commission. Administrative agencies may permit persons to intervene even though their interest may not be such as to entitle them to judicial review.

3. Section 2.102 of the Commission's rules of practice provides:

"(a) The AEC will, upon request of the applicant or an intervener, and may upon its own initiative, direct the holding of a formal hearing prior to taking

action on the application. If no prior formal hearing has been held and no notice of proposed action has been served as provided in paragraph (b) of this section, AEC will direct the holding of a formal hearing upon receipt of a request therefor from the applicant or an intervener within 30 days after the issuance of a license or other approval or a notice of denial.

"(b) In such cases at it deems appropriate, AEC may cause to be served upon the applicant, and published, a notice of proposed action upon his application and shall cause copies thereof to be served upon interveners or others entitled to or requesting notification. The notice shall state the terms of the proposed action. If a formal hearing has not been held prior to issuance of the notice, AEC will direct the holding of a formal hearing upon the request of the applicant or an intervener received within fifteen days following the service of the notice."

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4. The interveners' request for hearing was filed within the time specified in our rules. Accordingly, the application for a construction permit is being set down for hearing and referred to a hearing examiner to conduct a formal hearing.

5. In adopting Section 2.102 the Commission established alternative procedures with respect to the issuance of permits and licenses. Under the section, the Commission may order a prior hearing before taking action; or issue a notice of proposed construction permit or license allowing 15 days thereafter for filing requests for hearing;

or, as was done in the present proceeding, may issue a permit or license subject to the receipt within 30 days of a proper request for hearing from the applicant or an intervener. Whichever course is followed, the proceeding is not complete until the opportunities for hearing have expired, or if a hearing has been properly requested and allowed, such hearing has been held and the issues determined.

6. Since a proper and timely request for hearing has been made and allowed in this proceeding, the applicant for the permit must demonstrate at the hearing that it is able to satisfy those requirements of law and the Commission's regulations which are in controversy. For this reason, certain collateral matters raised by the interveners' petitions (such as their references to the phraseology of the construction permit) do not require consideration at this time.

7. Applicant's motion to strike certain allegations from the petitions raises questions of an evidentiary nature which are being left for determination during the hearing.

8. Since the permit does not authorize the applicant to possess or use any special nuclear or radioactive material and since activities authorized by the construction permit do not create nuclear hazards during the period of construction, the interveners' request for suspension of the construction permit pending

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the hearing is being denied, without prejudice to ultimate determination by the Commission as to whether the permit should be continued, modified or vacated.

9. The order contains a provision directing that copies of the report dated June 6, 1956, from C. Rogers McCullough, Chairman of the Advisory Committee on Reactor Safeguards, to K. E. Fields, General Manager, be sent to the interveners and placed in the Commission's Public Documents Room. This action is being taken because a copy of the Advisory Committee's report was sent to the Power Reactor Development Company on June 18, 1956, in connection with discussions between the AEC staff and representatives of the company. The Commission has concluded that the public interest would best be served in this instance by making the document available to the interveners and the public.

By LEWIS L. STRAUSS
Chairman

By WILLARD F. LIBBY
Commissioner

By HAROLD S. VANCE
Commissioner

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August 4, 1956

Power Reactor Development Company
1911 First Street
Detroit 26, Michigan

Gentlemen:

Enclosed is a construction permit issued by the Atomic Energy Commission authorizing Power Reactor Develop-

ment Company to construct the utilization facility described therein.

The issuance of this permit is based on the information and representations contained in your original application filed on January 7, 1956, and amendments thereto filed on June 6, 1956, July 12, 1956, July 20, 1956, and July 23, 1956, including PRDC's program for carrying out further investigation and experiments leading to the final design of the proposed reactor.

As specified in the construction permit, prior to taking action on the conversion of the construction permit to a license to operate the facility a final Hazards Summary Report must be submitted to AEC for evaluation and a determination that the reactor can, in fact, be operated without undue risk to the health and safety of the public.

As stated in the construction permit the Commission believes that the safety problems associated with the reactor will prove to be of a kind which can be resolved within a reasonable time. The Commission regards the fast breeder program as a very important program and will use its best efforts to assist the company to resolve these problems as completely and as quickly as possible. However, the Commission wants it to be clearly understood that in issuing this construction permit the emphasis is on the fact that it is a conditional one and that the Commission can make no commitment to convert the permit to a license until it is satisfied on all safety matters.

Also, as you are aware, PRDC has not submitted to date sufficient information for the Commission to make a finding with respect to financial qualifications. Paragraph 3d of

the permit contains a condition that its continued effectiveness will be dependent upon a showing within 12 months by

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PRDC that its financial resources are such as to enable the Commission to make the required finding, unless for good cause shown the Commission extends the time for submission of such data.

You will observe that the final paragraph of this permit establishes an allocation of 3.929 kilograms of contained U-235 for use in connection with the operation of this facility. This allocation represents the quantity of U-235 estimated to be required for burn-up and loses, plus inventory. You will also observe that shipments of U-235 by the Commission to PRDC in accordance with Schedule 1 of the Appendix to the permit will be conditioned upon PRDC's return to the Commission of material subsequently in accordance with schedule 2 of the Appendix. The issuance of this permit and the allocation of U-235 contained therein is not to be construed as a commitment by the Commission to supply the U-235 in any form except UF_6.

The issuance of this permit does not constitute a commitment on the part of the Commission to provide transportation or processing services with respect to the spent fuel.

Pursuant to established Commission policy, the Commission will undertake to supply PRDC's Boron-10 requirements, under appropriate terms and conditions and within the limitations of available supply, until such time as Boron-10 is available from a commercial source of supply.

An allocation of source material in the form of depleted uranium is not being made at this time pending completion of a study of the classification of this material.

Please communicate with us in the event you have any questions concerning any of the provisions of the construction permit.

Sincerely yours,

/s/ H. L. PRICE
Director, Division of Civilian Application

Enclosure

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OPINION OF COMMISSIONER MURRAY DISSENT IN PART

On August 2, 1956, the majority of the Commission authorized the issuance of a conditional construction permit to the Power Reactor Development Company. I did not concur with the majority because the information then before the Commission in my opinion was insufficient to provide reasonable assurance that a facility of the general type proposed could be constructed and operated at the proposed location without undue risk to the health and safety of the public. In this connection, I placed my principal reliance on a letter dated June 6, 1956 (a copy of which is attached) from the Advisory Committee on Reactor Safeguards, signed by C. Rogers McCullough, Chairman of the Committee.

As late as September 28, 1956, the Commission was informed that the Advisory Committee on Reactor Safe-

guards has not changed its position in respect to its letter of June 6th and also that there was no new information. Under these circumstances I am of the opinion that this permit should be suspended pending conclusion of the hearing in this matter.

In other respects I concur in the decision of the majority of the Commission.

By THOMAS E. MURRAY
Commissioner

[6368]

June 6, 1956

Mr. K. E. Fields
General Manager
U. S. Atomic Energy Commission
Washington 25, D. C.

SUBJECT: Power Reactor Development Company
(Atomic Power Development Associates)
Fast Power Reactor

(Reports APDA 108 and 114)

Dear Mr. Fields:

The present status of the reactor being proposed by the Power Reactor Development Company, associated with Atomic Power Development Associates, was reviewed by the Advisory Committee on Reactor Safeguards at its Eighteenth Meeting on June 3, 1956. This review included the design of the reactor, the state of information on the nuclear properties and the relation of the reactor to its

containment and its site. The proposed PRDC reactor represents a greater step beyond the existing state of the art than any other reactor of comparable power level which has been proposed by an industrial group.

From this review the following conclusions were derived:

1. Even though there are no facts or calculations available to the Committee that clearly indicate that the proposed reactor is not safe for this site, the Committee believes there is insufficient information available at this time to give assurance that the PRDC reactor can be operated at this site without public hazard.

2. It appears doubtful that sufficient experimental information will be available in time to give assurance of safe operation of this reactor unless the present fast reactor program of the AEC is amplified and accelerated as detailed below.

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3. It is impossible to say whether or not an accelerated program would give sufficient information to permit safe operation of this reactor at the Lagoona Beach site on the time schedule presently proposed.

The following program of investigation is suggested in order to provide information to judge the safety of the proposed operation.

1. The origin of the positive component of the temperature coefficient in EBR-I must be established. A clear demonstration must be given that a coefficient of this magnitude cannot exist in the PRDC design.

The experimental program required would involve three phases:

a. Study of the spontaneous behavior of a new EBR-I core designed with rigid fuel elements to insure against the possibility of bowing. Such a study might have to include experiments with both series and parallel flow through core and blanket.

b. Extensive studies of oscillator experiments on the PRDC design with a simulator, using a wide variety of component temperature coefficients and associated time constants. These studies should be designed to demonstrate that oscillator tests in the startup of the PRDC reactor can produce all the temperature coefficient information required to assure safe transient properties of the reactor, *i.e.*, a negative prompt temperature coefficient of sufficient magnitude to prevent a fuel melt-down.

c. Further experimental work on ZPR-III to show the magnitude and size of the Doppler effect in order to verify the theory.

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together with a reasonably complete theoretical understanding of their origin in terms of the mechanical design. This program has three aspects:

a. A demonstration by the simulator studies under 1b.—that the proposed startup program on PRDC can give the information required over a wide range of possible coefficients and time constants.

b. Conduct of oscillator studies on the EBR-II reactor to show that they are feasible and capable of being interpreted to give the necessary information.

c. Startup program on the PRDC reactor itself to obtain the final information needed before the reactor can be safely operated at full power without meteorological restrictions.

The objective of this program must be to ascertain whether the various negative coefficients are sufficient to prevent meltdown under any conceivable circumstances of control mal-operation.

3. The Committee as a whole was not satisfied with the evidence presented that no credible supercriticality accident resulting from meltdown could breach the container. It is felt that a more extensive theoretical and experimental program to examine all the possibilities needs to be established and pursued vigorously. The following are examples: mechanical mock-up studies designed to study distortion of core on sudden melting, criticality studies in ZPR-III design to investigate maximum supercritical arrangements, detailed design studies of the reactor structure, with supporting mock-up experiments, to insure sub-critical distribution of melted fuel and to assure that free fall of core parts cannot reassemble a critical mass suddenly.

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4. It is considered critically important that the EBR-II program be pursued more aggressively and

coordinated more closely with the PRDC design than is presently the case. The EBR-II program is the only program now constituted which could provide engineering information and operating experience on a high-power-density fast reactor in advance of the scheduled date for operation of the PRDC reactor.

The nature and content of the EBR-II program which the Committee considers essential depends on the outcome of investigation 3 above. If it can be shown that a supercritical accident with sufficient energy release to breach the building cannot take place, then the EBR-II program should be aimed at providing general engineering information relevant to the economical design and safe operation of the PRDC reactor.

On the other hand, if it cannot be shown that breaching of the building during a meltdown is impossible, then a much more extensive EBR-II program is required. The test reactor to be operated as EBR-II should then to be a genuine prototype of the PRDC reactor. The fuel elements of the test reactor should be identical in all essentials to those proposed for the PRDC reactor, and operated at power densities at least as high as those to be used in the PRDC reactor. The static and dynamic properties of the test reactor should be fully investigated, completely understood theoretically and proved incapable of causing meltdown. These properties should be investigated both for the reactor with its initial charge of U-235 and U-238 and for the

reactor with the steady-state concentration of plutonium in the core.

5. The program should not be limited to the above points but should be broadened to

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whatever extent may be shown necessary by the program itself.

The Committee wishes to note that the experience that now exists on fast power reactors of high power density is not wholly reassuring. While the EBR-I incident is not directly relevant in this connection because the reactor was known to possess an unstable prompt power coefficient under the conditions of the terminal experiment, nevertheless the fact remains that the origin of this unstable coefficient has not been clearly established and therefore its possible occurrence in the PRDC design cannot be definitely excluded on the basis of present experimental information. Opinions differ as to whether its absence can be completely assured in a safe way by the oscillator tests in the pre-startup program proposed for the PRDC reactor *in situ*.

The Committee considers it important that bold steps be taken to advance the development of the fast breeder reactor concept and commends the willingness of the Power Reactor Development Company to risk its capital and prestige in advancing the development of this reactor concept. But the Committee does not feel that the steps to be taken should be so bold as to risk the health and safety of

the public. It is important for the AEC to provide sufficient development facilities and experimental information that the safety aspects of the PRDC reactor can be reliably appraised in advance of operation of the reactor itself.

Sincerely yours,

/s/ C. ROGERS McCULLOUGH
C. ROGERS McCULLOUGH
Chairman
Advisory Committee on Reactor Safeguards

* APDA-108 Description of Developmental Fast Neutron Breeder Power Reactor Plant, Sept. 1, 1955.

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Intervenors' Answer to Order of Commission

UNITED STATES OF AMERICA
ATOMIC ENERGY COMMISSION

In the Matter
of
LICENSE APPLICATION OF POWER REACTOR DEVELOPMENT COMPANY.

AEC Docket No. F-16.

ANSWER OF INTERVENORS

NOW COME the International Union, United Automobile, Aircraft and Agricultural Implement Workers of

America, AFL-CIO, Walter P. Reuther, Emil Mazey, and Carlos Gastambide, *et al.*; the International Union of Electrical, Radio and Machine Workers, AFL-CIO, James B. Carey Al Hartnett and James Douglas, *et al.*; the International Union, United Paperworkers of America, AFL-CIO, Harry Sayre, Frank Grasso, Max Van Wickle, Joseph Stanifer, Lawrence Helten, John Jennings, and Frank Meade, Jr., *et al.*, hereinafter referred to as Intervenors and for answer to the Order of the Atomic Energy Commission (hereinafter referred to as Commission or AEC) dated October 8, 1956, state as follows:

1. With respect to the issue denominated as A (1) in the Commission's Order of October 8, 1956, the Intervenors deny that there is information sufficient to provide reasonable assurance that a utilization facility of the general type proposed in the application can be constructed and operated at the location proposed therein without undue risk to the health and safety of the public.

2. With respect to the issue denominated as A (2) in the Commission's Order of October 8, 1956, the Intervenors deny that there is reasonable assurance that technical information omitted from and required to complete the application will be supplied by PRDC in a form justifying issuance of any construction permit.

3. The Atomic Energy Act of 1954, hereinafter referred to as Act, prohibits construction of a utilization facility except pursuant to a construction permit, and Section 50.35 of the Commission's regulations requires a finding by AEC that there is

> "reasonable assurance that a facility of the general type proposed can be constructed and operated at the

proposed location without undue risk to the health and safety of the public * * *"

as a prerequisite to issuance of a construction permit on a provisional basis.

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4. At the time AEC issued the "conditional" construction permit to PRDC on August 4, 1956, PRDC had not submitted sufficient information to AEC to provide such "reasonable assurance".

5. AEC's issuance of the "conditional" construction permit on August 4, 1956, was arbitrary, erroneous, and contrary to law since the required finding of "reasonable assurance" had not been made, and the findings which AEC did make, *i.e.*, that there existed "identified" and "unidentified" "areas of uncertainty" regarding the hazards potential of the type of reactor proposed by PRDC, were inconsistent with, contrary to, and precluded the required finding of "reasonable assurance".

6. With respect to the issue denominated as B in the Commission's Order of October 8, 1956, the Intervenors deny that the applicant is financially qualified to engage in the proposed activities pursuant to Section 50.40 (b) of the Commission's regulations, and deny that the applicant is financially qualified to receive an allocation of special nuclear material pursuant to Section 50.60 (c)(2) of the Commission's regulations.

7. The Act and Sections 50.40 [redacted]nd 50.45, Title 10, CFR, require the AEC find, as a condition of issuing a construction permit on any basis, that the applicant is

"financially qualified to engage in the proposed activities" in accordance with AEC regulations.

8. Section 50.60, Title 10, CFR, requires that before AEC includes in a construction permit any allocation of special nuclear material it must find that:

> "The applicant appears to be financially qualified to assume responsibilty for the payment of Commission charges for the material and to undertake and carry out the proposed use of special nuclear material for a reasonable period of time * * *"

9. At the time AEC issued the "conditional" construction permit to PRDC on August 4, 1956, PRDC had not established its financial qualifications, and AEC itself stated in the "conditional" construction permit that:

> "* * * the evidence submitted to date does not justify a finding with respect to the financial qualifications of PRDC."

10. The license application filed by PRDC indicates that PRDC has made its financial qualification dependent upon: (a) statutory exemption of PRDC and its member-companies from the provisions of the Public Utility Holding Company Act; (b) a ruling by the Internal Revenue Service that contributions by its members to PRDC are deductible for federal income tax purposes; and (c) provisions for adequate

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insurance protection against liability for damage claims arising from a catastrophe caused by its reactor. None of these three conditions had been met at the time the

"conditional" construction permit was issued, and none of them has been met at the present time. In addition, PRDC's financial qualification is dependent upon execution of a contract for AEC financial assistance under the Power Demonstration Reactor Program, and execution of this contract is in turn dependent upon the United States Government's acceding to the aforesaid three conditions.

11. AEC acted illegally, contrary to the provisions of the Act, and contrary to the provisions of its own rules and regulations, in issuing to PRDC a "conditional" construction permit and in including in the permit an allocation of special nuclear material without the aforesaid requisite findings of "financial qualification".

12. With respect to the issue denominated as C in the Commission's Order of October 8, 1956, the Intervenors oppose the granting of a specific exemption to PRDC pursuant to Section 50.12 of the Commission's regulations.

13. The specific exemption contemplated in Section 50.12, Title 10, CFR, may be granted only "upon application by any interested person". Neither PRDC nor any other person has requested such a specific exemption under Section 50.12.

14. Section 50.12, Title 10, CFR is invalid insofar as it is applicable to construction permits issued under Section 104 (b) of the Act. If it is a valid regulation under the provisions of the Act, it does not permit granting of an exemption to PRDC as a result of which any construction permit could issue to PRDC.

15. Any specific exemption from the requirement of AEC's rules and regulations relating to the necessity for

a finding of "reasonable assurance" as set forth in paragraph 3 hereof, or for a finding of "financial qualification" as set forth in paragraphs 7 and 8 hereof, would be contrary to law.

16. A specific exemption from the requirements of AEC's rules and regulations relating to the necessity for a finding of "reasonable assurance", as set forth in paragraph 3 hereof, or for establishment of and a finding of "financial qualification", as set forth in paragraphs 7 and 8 hereof, would be inimical to the health and safety of the public and would be contrary to the public interest.

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17. Under Section 3 (d) of the Act, peaceful applications of atomic energy must be "consistent * * * with the health and safety of the public", and Section 104 (d) prohibits the issuance of a construction permit when issuance "would be inimical * * * to the health and safety of the public". In the present state of the art of fast breeder reactors, this type of reactor is "the most hazardous of all reactors", and such a reactor should not be constructed near metropolitan population centers until it or a prototype has been constructed, tested and experimentally proven at a location distant from population centers. In permitting construction of this reactor at the Lagoona Beach site at this time, AEC has violated the Atomic Energy Act of 1954, and its own rules and regulations.

18. PRDC was influenced by AEC or its representatives to undertake precipitously a program for construction of its fast breeder reactor, prior to resolution of safety hazards known to exist and prior to establishment

of the financial qualifications of PRDC. Such action by AEC or its representatives, as well as their public utterances on this matter, had a strong tendency to affect the Commission's judgment in acting on the license application of PRDC.

19. With respect to the issue denominated as D in the Commission's Order of October 8, 1956, the Intervenors state that no modification of or amendments to the "conditional" construction permit of August 4, 1956, can remedy the serious hazards to the health and safety of the public which would be occasioned by operation of the PRDC reactor at the Lagoona Beach site under present and presently foreseeable technological conditions.

20. The Intervenors reserve the right to take a position at a future date on any modification of or amendments to the "conditional" construction permit which may be proposed.

21. Intervenors will appear at the hearing ordered by the Commission and will present evidence and argument in support of the foregoing allegations.

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22. The Intervenors pray that the AEC rescind and declare a nullity the "conditional" construction permit issued to PRDC until such time as there has been full compliance with all pertinent provisions of the Atomic Energy Act of 1954 and the Commission's rules and regulations.

.....

HAROLD A. CRANEFIELD

.....

BENJAMIN C. SIGAL

.....

HAROLD P. GREEN

.....

LOWELL GOERLICH

Attorneys for Intervenors.

October 19, 1956

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PRDC Answer to Order of Commission

UNITED STATES OF AMERICA

ATOMIC ENERGY COMMISSION

In the Matter

of

POWER REACTOR DEVELOPMENT COMPANY.

Docket No. F-16.

ANSWER OF POWER REACTOR DEVELOPMENT COMPANY TO NOTICE OF HEARING AND ORDER

NOW COMES Power Reactor Development Company, a non-profit corporation organized and existing under and by virtue of the laws of the State of Michigan, and for answer to the specification of issues set forth in the certain

Notice of Hearing and Order of the Atomic Energy Commission dated October 8, 1956, says as follows:

1. There is sufficient information to provide reasonable assurance that a utilization facility of the general type proposed in the Application dated January 7, 1956, as amended, submitted by Power Reactor Development Company to the Atomic Energy Commission can be constructed and operated in the location proposed in the said application without undue risk to the health and safety of the public.

2. There is reasonable assurance that technical information omitted from the said Application, and which is required to be filed to complete the said Application, will be supplied.

3. Power Reactor Development Company is financially qualified to engage in the activities proposed by the said Application and is financially qualified to receive an allocation of special nuclear materials.

[6393]

4. The Atomic Energy Commission is authorized to, and should, grant to Power Reactor Development Company such exemptions from the requirements of the Regulations of Part 50, Title 10, C. F. R., with respect to any matter in issue in these proceedings as will not endanger life or property or the common defense and security and as may appear necessary to enable Power Reactor Development Company to proceed with the design and construction of the utilization facility proposed in the said Application as the development and construction of the proposed facility is of paramount importance to implementation

of the public and national interest in the development of peaceful uses of atomic energy.

5. The grant of exemption from provisions of the Regulations of Part 50, Title 10, C. F. R., by the Atomic Energy Commission to Power Reactor Development Company in respect of matters which will not endanger life or property or the common defense and security is clearly warranted by the policy of the Power Demonstration Reactor Program of the said Commission and by Section 104(b) of the Atomic Energy Act of 1954, as amended, which provides for the issuance of licenses (construction permits), subject to the minimum amount of regulations and conditions compatible with the protection of the health and safety of the public.

6. The issuance by the Atomic Energy Commission of a construction permit for the construction of a utilization facility of the general type proposed by Power Reactor Development Company in the aforesaid Application, as amended, is not a violation of any provision of the Atomic Energy Act of 1954, or of the Regulations promulgated pursuant thereto by the said Commission, nor does issuance of such

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construction permit create a hazard to the health and safety of the public or to property.

7. The Regulations of the Atomic Energy Commission, which provide for the conversion of a construction permit to an operating license, to wit, Sections 50, 56, Title 10, C. F. R., amply protect the interest of the public health and safety by conditioning such conversion upon comple-

tion of construction in compliance with the terms and conditions of the construction permit as it may be amended from time to time and upon the conduct of tests in connection with assuring the health and safety of the public. All construction permits are, therefore, provisional and all holders of such permits are subject to the possibility that an operating license will not issue after completion of construction of the facility.

8. The provisions of the Atomic Energy Act do not require of the Atomic Energy Commission that it find that the health and safety of the public be assured in order to grant a construction permit but do require, and properly so, that such a finding be made before a facility can be operated.

9. Power Reactor Development Company will appear at the hearing set by the Atomic Energy Commission and present evidence upon the matters at issue.

WHEREFORE, Power Reactor Development Company prays that the Atomic Energy Commission

1. Determine that there is sufficient information to provide reasonable assurance that a utilization facility of the general type proposed by Power Reactor Development Company can be constructed and operated in the location proposed without undue risk to the health and

[6395]

safety to the public.

2. Determine that there is reasonable assurance that technical information omitted from the Application, as

amended, heretofore, filed by Power Reactor Development Company and which is required to be filed to complete said Application, will be supplied.

3. Determine that Power Reactor Development Company is financially qualified to engage in the activities proposed by the said Application and is financially qualified to receive an allocation of special nuclear materials.

4. Grant to Power Reactor Development Company such exemptions as will not endanger life or property or the common defense and security from the requirements of the Regulations of Part 50, Title 10, C. F. R., as may appear necessary to enable Power Reactor Development Company to proceed with the design and construction of the utilization facility proposed in the said Application.

5. Continue in effect the construction permit heretofore issued to Power Reactor Development Company with such additional or different provisions and/or conditions which the Commission may deem to be necessary in the public interest.

MILLER, CANFIELD, PADDOCK AND STONE

By /s/ EDWARD S. REID, JR.
Edward S. Reid, Jr.

And /s/ RICHARD B. GUSHEE
Richard B. Gushee
Attorneys for Power Reactor Development Company
3456 Penobscot Building
Detroit 26, Michigan
Woodward 3-6420

[6660]

Commission's Order Extending Time for Submission of Financial Information, August 8, 1957

UNITED STATES OF AMERICA

ATOMIC ENERGY COMMISSION

In the Matter
of
POWER REACTOR DEVELOPMENT COMPANY.

Docket No. F-16.

ORDER EXTENDING TIME

At a session of the Atomic Energy Commission held in Washington, D. C., on the 31st day of July, 1957, Chairman Lewis Y. Strauss and Commissioners Willard F. Libby and Harold S. Vance present, it appeared that:

The provisional construction permit issued to Applicant dated August 4, 1956, was subject to the following condition:

> "D. Unless, within twelve months from the date of this construction permit, PRDC submits sufficient information relating to its financial resources to enable the Commission to make a finding that the Company has adequate financial resources to meet the requirements of the law and the regulations, this permit shall expire; provided that the Commission may for good

cause shown extend the time for the submission of such data."

By order dated October 8, 1956, the Commission directed that a hearing be held on the application for construction permit upon certain issues, including the following:

"B. Whether, pursuant to Section 50.40(b) of the Commission's regulations, the applicant is financially qualified to engage in the proposed activities; and whether, pursuant to Section 50.60(c)(2) of the Commission's regulations, the applicant is financially qualified to receive an allocation of special nuclear material."

Extensive evidence relating to these issues of financial qualification has been introduced at the hearing in this proceeding. Much of that evidence has also been embodied in amendments to the License Application. Additional evidence

[6661]

relating to these issues may be introduced prior to the conclusion of the hearing. The Commission has not evaluated such evidence and does not contemplate doing so until after the record of the hearing is certified to it for its decision as provided in its Order of October 8, 1956.

The Applicant, by letter to the Director of Civilian Application, copies of which were sent to counsel for the remaining parties in this proceeding, has requested an extension of time specified in the aforesaid paragraph D for submission and evaluation of the requisite financial information until such time as the hearing now in progress

has been completed and the Commission has rendered its determination thereon.

Upon due consideration of the foregoing, and upon determination that good cause for such action has been shown;

It is Ordered That:

(1) Any evidence received at the hearing which is relevant to the issues of financial qualification shall be deemed information submitted in compliance with the requirement of the aforesaid paragraph D of the provisional construction permit.

(2) The time specified in the aforesaid paragraph D for submission and evaluation of any such information is extended until such time as the hearing required by the Commission's Order of October 8, 1956, is completed and the Commission has rendered its determination thereon.

UNITED STATES ATOMIC ENERGY COMMISSION

By .....
Secretary

Dated: August 1, 1957

(SEAL)

[6873]

Findings and Decision of Commission, December 10, 1958

In addition to the facts found and conclusions of law reached in the course of the opinion, the Commission specifically finds and concludes:

1. Power Reactor Development Company (PRDC) is a duly organized non-profit corporation existing under the laws of the State of Michigan, and its operations will, if conducted according to the construction permit issued by this Commission dated August 4, 1956, be subject to the Atomic Energy Act of 1954, amendments thereto and the Rules and Regulations issued by this Commission.

2. PRDC has proposed the construction and, subject to later proceedings, the operation of utilization and production facilities as defined in Section 104 of the Atomic Energy Act and the Rules of this Commission, as a research and development facility consisting of a fast breeder nuclear reactor of 300,000 thermal kilowatts and 100,000 electric kilowatts capacity and having physical features described in the application and the ten amendments thereto which constitute a part of the files and record of the proceeding.

3. PRDC has been issued a construction permit on a provisional basis to construct a fast breeder reactor of the general type set forth in its application as amended prior to August 4, 1956. Developments in design resulting from improvements in technology require changes in and additions to some of the terms and conditions of the construction permit previously issued. These changes and additions are reflected in the amended construction permit attached hereto and made a part of our order.

[6874]

4. AEC interest in fast neutron systems goes back several years. Both AEC and the United Kingdom have operated a number of small uncooled critical assemblies and flexible critical experiments. AEC has operated two fast

reactors, "Clementine," a 25 thermal kilowatt plutonium-fueled reactor which operated from 1946-1952 and EBR-I, a 1400 thermal kilowatt (200 electrical kilowatt) uranium-fueled reactor which operated at the National Reactor Testing Station, Idaho, from August 1951-November 1955. The following fast reactors, in addition to Applicant's proposed reactor, are presently programmed:

a. EBR-I is being placed back into operation with two new cores, Mark III and Mark IV. The Commission takes official notice that EBR-I with the Mark III core became operational in November, 1957.

b. EBR-II, a 62,500 thermal kilowatt, (20,000 electrical kilowatt) uranium-fueled reactor, will be constructed at the National Reactor Testing Station in Idaho. The Commission takes official notice that funds for construction of EBR-II have been authorized and that construction of EBR-II is currently scheduled to be completed in December, 1959.

c. A uranium-fueled reactor with a rated capacity of 60,000 thermal kilowatts is presently under construction at Dounreay, Scotland, by the United Kingdom and is scheduled for completion in December of 1958.

[6875]

5. Technology regarding fast breeder nuclear reactors is a rapidly advancing art and utilization and production facilities that will permit the most complete use of fuel for atomic energy offer a substantial advancement in this field. The research and development project proposed by PRLC reflects the largest plant in the United States to date which would utilize energy produced by the fast breeder process.

Information is increasing as experiments and corroborative data are supplied regarding the safety in operation of such a plant. Several experiments with existing or proposed fast breeder reactor plants will provide information helpful in the consideration of the operation of the PRDC plant. There is no inherent hazard or danger to the health and safety of the public in the construction or operation of fast breeder reactors.

6. The EBR-II and PRDC reactors are similar in neutron spectrum and flux, power density, fuel element design and coolant operating conditions, but differ in a number of design aspects. Both are based on EBR-I. EBR-II has a more advanced design, and is intended as a flexible experimental facility.

7. The Dounreay and PRDC reactors operate in the same neutron spectrum and have many common characteristics, but also have many differences in detail.

8. Neither EBR-I, EBR-II, nor Dounreay can be considered a direct prototype of the PRDC reactor.

[6876]

9. There is considerable experience in the use of sodium and related materials as coolants, including investigations of sodium technology at Commission laboratories since 1945; operation of EBR-I, the submarine intermediate reactor, and the sodium reactor experiment at Santa Susana, California; and performance tests on mock-ups of the EBR-II sodium system. In general, these sodium systems have operated successfully and have demonstrated the ability to

achieve satisfactory purity of sodium and to avoid significant corrosion.

10. Construction of the proposed PRDC reactor on the proposed time schedule represents a greater and more rapid extension of reactor technology beyond demonstrated practice than construction of the other civilian power reactors presently being completed in populated places.

11. The proposed experiments with the EBR-I Mark III core are intended to determine definitively whether bowing is the cause of the positive temperature coefficient observed in EBR-I. If properly carried out, they are expected definitively to establish the correctness or incorrectness of the bowing hypothesis.

12. It is highly probable that bowing can be prevented by proper mechanical design. Applicant has proposed three means of preventing inward bowing of the PRDC core.

13. There is still considerable doubt about the cause of the resonance instabilities observed in EBR-I. They may be attributable to the use of series rather than parallel flow of the coolant through the core and

blanket, and the experiments with the Mark III core are designed to test this hypothesis. The PRDC design proposes parallel flow.

14. Apart from certain problems of prompt acting positive temperature coefficients and resonance effects, the answers to which are not yet completely known, fast reactors are generally considered to be as easy to control as thermal

reactors. Indeed, it is possible to operate a fast reactor with a relatively small amount of excess reactivity available, thereby ensuring that an accidental sudden withdrawal of all controls will not result in a dangerous nuclear runaway. PRDC proposes, at least during the early years of operation, to adhere to such a limitation of excess reactivity.

15. Although many questions remain to be answered regarding the problem of meltdown and disassembly or reassembly of the core or a substantial portion thereof, the existence of these problems does not negate the likelihood that they will be answered in due course and in time for the answers to precede any decision of the Commission with regard to an operating license for the proposed PRDC reactor; likewise, design modifications may be available as a means of avoiding these problems.

16. In view of the relative lack of operating experience with fast power reactors, additional satisfactory operating experience with such reactors prior to the commencement of operation of Applicant's proposed reactor will be highly desirable. Present schedules indicate that considerable operating experience with EBR-I and Dounreay, and possibly some with EBR-II, will have been obtained prior to the start of PRDC test operations.

[6878]

17. It is possible that there may be presently unknown effects in large fast reactor systems. A prototype of the proposed reactor at a remote location has been urged as affording greater assurance against the possibility of such

unknown effects than does the presently planned experimental and theoretical programs. The Commission finds that the necessity, however, for constructing such a prototype has not been shown. If the program of meltdown investigation should prove inconclusive, it will be necessary to reconsider the question of need for a prototype.

18. Based on the foregoing findings, the Commission further finds—

a. that it has not yet been positively established that a fast breeder reactor of the general type and power level proposed by Applicant can be *operated* without a credible possibility of releasing significant quantities of fission products to the environment;

b. that there is reasonable assurance that theoretical and experimental investigations which have been undertaken, together with operating experience on one or more of the EBR-I, EBR-II and Dounreay reactors, will establish definitively, prior to the scheduled completion date of the PRDC reactor, whether or not the reactor proposed by Applicant can be so operated;

c. that it is probable that evidence will establish that the reactor proposed by Applicant can be so operated.

[6879]

19. The proposed site is located on the shore of Lake Erie about thirty miles from Detroit, Michigan, twenty-five miles from Toledo, Ohio, seven and one-half miles from Monroe, Michigan, and ten miles from the Canadian border. The site is bordered on one side by water and provides an exclusion area on the land side with a minimum radius of

2900 feet. The population distribution for given distances from the site is as follows:

Miles	*Population*
1	175
2	600
5	1,800
10	31,300
20	187,100
30	2,001,700

During the summer months the population within five miles would be increased due to vacating transients and to the fact that beaches two to five miles southwest of the site may be crowded with thousands of people.

20. The site is satisfactory from structural and underground water flow standpoints. The meteorology of the site is complex, but no reason is known for it to be disqualifying. Studies of the meteorology, lake currents, air diffusion, flooding and other problems will be completed before the question of a license to operate is before the Commission. Design modifications required by the results of those studies can be considered at that time.

[6880]

21. A definitive evaluation of the suitability of the proposed site cannot be made at the present time. In view of the population density around the site, its suitability for the proposed reactor depends upon the inherent safety of the reactor and a demonstration that no credible accident can release significant quantities of fission products into the atmosphere. If the foregoing are established, and there is

reasonable assurance that they can be, it is probable that the site will prove suitable for the proposed reactor.

22. The Commission finds reasonable assurance in the record that a utilization facility of the general type proposed in the PRDC application and amendments thereto can be constructed and will be able to be operated at the location proposed without undue risk to the health and safety of the public.

23. Applicant's current estimate for the cost of construction, preconstruction research and development, and administrative expenses during construction and test operation is $44,020,000. It has assets, consisting of firm commitments for contributions from members and an executed bank loan agreement, totalling $49,448,000 and thus exceeding its estimated costs by $5,428,000. The member companies of PRDC should provide additional funds, if necessary, to take care of adverse contingencies. Applicant's utility members have combined equity assets of $2 billion.

[6881]

24. There is a reasonable possibility of a cost over-run on construction and research and development, and increases have already occurred on specific items. The record, however, does not demonstrate that such an over-run will exceed Applicant's available assets by any amount and especially by an amount large enough to disprove PRDC's financial qualification.

25. Provision is made in Applicant's cost estimates for payment of Commission charges for use and burn-up of

source and depleted material. The amount of possible Commission charge for loss of depleted and special nuclear material has not been identified and will depend on determination of the magnitude and consequences of the maximum credible accident. Applicant believes that in any accident a substantial part of the material would be reclaimable and that its exposure to a charge for loss is on the order of $1 million. It expects to cover its potential liability for loss by either insurance, application of its unencumbered assets, or a guarantee from its sponsors. The Commission finds that Applicant has shown a reasonable probability of being able to pay Commission charges for loss of special nuclear material through 1963.

26. The fast breeder reactor is one of the promising types for the development of electric power on a commercially feasible basis. Demonstration of the economic practicability of breeding would increase by many times the available reserves of nuclear fuel by facilitating the conversion into plutonium and use as fuel the uranium-238 isotope which comprises 99.3% of the natural uranium.

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27. By proceeding with construction and further research and development simultaneously, rather than awaiting complete research and development results, Applicant will save several years in the time required to place in operation its demonstration power reactor.

28. The proposed reactor will be a utilization facility within the meaning of 10 CFR 50.2(b) and will be involved in the conduct of research and development activities lead-

ing to the demonstration of the practical value of such facilities for industrial and commercial purposes.

29. Applicant and the organizations with which it is associated by contract are technically qualified to design and construct the reactor described in the Application.

30. Data presently available indicate that a reactor of the general type described in the Application can be so designed that no credible accident in the course of its operation is likely to result in the release of significant quantities of fission products into the atmosphere; this conclusion has not been demonstrated sufficiently at this time to justify issuance of an operating license.

31. Theoretical and experimental programs are underway that should establish the conclusion stated in paragraph 30 sufficiently to justify the issuance of an operating license; the record shows a definite preponderance of expert opinion to this effect, and the results of these programs should be available prior to the time it is necessary for the Commission to rule on the operating aspect of license application.

[6883]

32. The proposed site is generally suitable for a reactor of the type and size described in the Application, if the reactor is otherwise shown to be capable of operation without undue hazard, including demonstrations of stability and adequate containment. Adequate investigations are under way to establish the characteristics of the chosen site, including all relevant aspects, and the record shows

that to this point the site is satisfactory from the standpoint of protection of the public from undue hazard.

33. There is reasonable assurance that technical information omitted from the Application and required to complete the Application will be supplied prior to the time when it is necessary for the Commission to rule on the license application itself.

34. The Applicant is financially qualified to engage in the construction and operation of the reactor described in the Application and to receive the allocation of special nuclear material therefor.

35. The issuance of a construction permit to the Applicant will not be inimical to the common defense and security or to the health and safety of the public.

36. Procedure for continuing review of the PRDC project must be established, as hereinafter ordered, so as to require both PRDC and the separated staff of the AEC, and to permit the Interveners in this proceeding, to submit to all participants in the proceeding, as well as file with the Secretary of the Commission, where they will be publicly

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available, data coming to the attention of any one of them pertinent to safety in construction, design and operating characteristics of fast breeder nuclear reactors similar or identical to the PRDC project, thus to enable the Commission to consider such data and to provide for a further hearing in this instant matter, if deemed advisable prior to the final license proceeding. It is not anticipated that a

hearing would be advisable or necessary upon the filing of each portion of data, but when any single filing itself or the accumulation of data filed warrants, the Commission intends on either its own motion or the motion of one of the participants to set a hearing to provide for further review of safety considerations.

37. Proceedings for a license to *operate* the proposed PRDC plant shall be held at a time later to be determined, after the completion of construction. In that proceeding the safety considerations of the PRDC project will be in issue, and we shall again consider whether the PRDC plant can be operated with reasonable assurance for the protection of the health and safety of the public. Commissioners Vance and Floberg join in this opinion. Commissioner Graham concurs as shown by his accompanying separate opinion. Commissioner Libby was absent from the oral argument because of illness and took no part in the consideration or decision in this case. Chairman McCone's term as a Commissioner commenced after the date of oral argument, and he took no part in the consideration or decision in this case.

HAROLD S. VANCE
Commissioner

JOHN F. FLOBERG
Commissioner

[6885]

Graham, Commissioner (concurring): My analysis of the case leads me to concur on grounds stated below without the extensive comment and broad treatment set forth in the majority opinion. The findings of fact in the main body of that opinion seem quite sufficient to me to dispose of the case.

The issues originally set forth by the Commission in the October 8, 1956, notice of hearing, order and memorandum directing that a hearing be held before Mr. Jay A. Kyle, Examiner, are quoted in full in the body of the opinion. I need not restate them here.

With regard to Issue A, Part 1, I believe that the record contains sufficient evidence, for the present purposes, to provide reasonable assurance that a facility of the general type proposed can be constructed and operated at this proposed location without undue risk to the health and safety of the public. It is not necessary for the Commission now to require absolute assurance. That issue will be finally decided later. With regard to Issue A, Part 2, there is also reasonable assurance, if the applicant complies with the interim order, that adequate technical information will be supplied and the application completed before the Commission determines whether a license should issue.

Issues B, C, and D of the original order are disposed of by the main body of the opinion of my colleagues and by what follows herein.

The record indicates that none of the questions relating to reactor safety, the feasibility of the reactor design, and the adequacy of the financing can be absolutely and finally answered at this time. Consequently an interim order is being entered which in essence specifically reserves

[6886]

to the Commission its responsibility to rule upon such questions at any time prior to the consideration of an ap-

plication for a operating license. The interim order requires periodic reports from PRDC and APDA to be filed with the Secretary of the Commission. These are to be served on the Interveners and also are to be made available to other interested persons. Such reports are designed to bring up to date the data relating to the scientific and technical investigations as well as to reveal current financial status of the project.

The interim order permits the continuance of construction of this project, subject to faithful performance of the conditions required with respect to reporting. Continuance of this construction permit is not to convey to the applicant that it has gained any assurance of favorable action if, and when, an application is made for a permit to operate the reactor facility.

JOHN S. GRAHAM
Commissioner

[6887]

UNITED STATES OF AMERICA
ATOMIC ENERGY COMMISSION

In the Matter
of
POWER REACTOR DEVELOPMENT COMPANY.

Docket No. F-16

ORDER

On the basis of the Opinion and Initial Decision adopted this day in the above entitled cause, the Commission hereby orders that:

A. The construction permit heretofore issued to Power Reactor Development Company on August 4, 1956, is hereby affirmed and continued in effect with such modifications and additions as are shown in the permit hereto attached and made a part of this order.

B. The amendments filed by PRDC after the issuance of the provisional construction permit on August 4, 1956, are added to and incorporated in the record.

C. Procedure is hereby established for continuing review of the safety characteristics of the PRDC fast breeder nuclear reactor plant. PRDC and the separated staff of this Commission are directed, and

any intervener herein is permitted, to serve upon all participants herein and to file with the Secretary of this Commission, who will make them publicly available to anyone concerned, data pertinent to the safety in construction, design and operating characteristics of fast breeder nuclear reactors similar or identical to the PRDC project so as to permit

[6888],

review by the Commission, which may set down for hearing, when deemed advisable, the further consideration of such date.

D. The application by PRDC for exemptions from any of the Regulations of this Commission is denied.

WOODFORD B. McCOOL
Secretary

Dated: December 10, 1958

SEAL

[6889]

UNITED STATES OF AMERICA
ATOMIC ENERGY COMMISSION

In the Matter
of
POWER REACTOR DEVELOPMENT COMPANY.

Docket No. E-16

CONSTRUCTION PERMIT AS AMENDED

The Construction Permit heretofore issued in this proceeding is amended to read as follows:

Pursuant to the Atomic Energy Act of 1954, as amended, and Title 10, CFR Chapter 1, Part 50, "Licensing of Production and Utilization Facilities", the Commission hereby issues a provisional construction permit to Power Reactor Development Company, a Michigan corporation, (hereinafter "PRDC") to construct the facility described herein as a utilization facility in accordance with the application and amendments thereto filed in this docket. This permit shall be deemed to contain and be subject to the conditions specified in Sections 50.54 and 50.55 of said regulations; is subject to all applicable provisions of the Atomic Energy Act of 1954, as amended, and rules, regulations and orders of the Atomic Energy Commission now or hereafter in effect; and is subject to any additional conditions specified or incorporated below:

A. The earliest date for completion of the facility is December 15, 1959. The latest date for completion of the facility is December 15, 1960. The term "completion date" as used herein means the date on which the construction of the reactor is completed except for the introduction of the fuel material.

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B. The site proposed for the facility is the location known as Lagoona Beach, Monroe County, Michigan, described in the application.

C. The general type of facility authorized for construction is an enriched uranium fueled, sodium cooled fast neutron breeder reactor designed to produce approximately 100,000 kilowatts of electrical energy, with associated structures, as described in the application, and the amendments filed thereto.

D. The applicant may proceed to design and construct the proposed facility without further authorization in accordance with the application and the amendments thereto filed in this proceeding and heretofore made a part of the record herein. This permit, however, does not constitute final approval of any technical specification of the facility. Before a license is issued to operate the facility, the Commission must finally approve all technical specifications. If the applicant desires any final approval of any particular specification prior to the issuance of a license to operate, it may request that the Commission grant specific approval of any specification by appropriate amendment to this permit.

E. Within three (3) months from the date of this amended permit and at three-month intervals thereafter, or less if in its judgment significant changes or developments have occurred, Applicant shall submit, under oath or affirmation, reports showing—

1. The status of technical investigations being conducted by or for PRDC on the following subjects, and any results obtained therefrom:

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a. stability of fast reactors, including autocatalytic and resonance effects;

b. revised temperature and power coefficients of the proposed PRDC reactor;

c. validity of oscillator technique to determine either of the foregoing;

d. possibility and consequences of meltdown of a core of a fast reactor;

e. adequacy of containment proposed for PRDC reactor, including missile effects;

f. meteorology, hydrology, lake current and flooding studies, and other significant environmental information concerning the proposed site;

g. analysis of maximum credible accident.

2. Decisions made by Applicant as to any design changes referred to in the written testimony in this proceeding, and any other design changes of the facility significantly affecting public safety;

3. Status of construction of the project, scheduled dates of design freezes on major components, and any changes in scheduled completion date.

F. Within six months from the date of this permit and at six-month intervals thereafter, Applicant shall submit reports, under oath or affirmation, showing financial statements of PRDC and APDA, current cost

estimates for construction and research and development in connection with the project, and a current statement of source and allocation of case during a ten-year operating period.

This permit is provisional to the extent that a license authorizing operation of the facility will not be issued by the Commission unless PRDC has submitted to the Commission (by proposed amendment to the application) the complete, final Hazards Summary Report (portions of which may be submitted and evaluated from time to time) and the Commission has found that the final design provides reasonable assurance that the health and safety of the public will not be endangered by operation of the facility in accordance with the specific procedures.

It is further provisional to the extent that the Commission reserves jurisdiction, at any time prior to issuance of an operating license, upon notice to the parties herein, to reopen this proceeding for the purpose of receiving additional evidence, and to make such determinations and take such action with respect to the continuance, vacation, or modification of this permit as the entire record warrants.

Upon completion (as defined in Paragraph A above) of the construction of the facility in accordance with the terms

and conditions of this permit, as amended, upon the filing of any additional information needed to bring the original application up to date, upon filing of proof of financial protection and execution of an indemnity agreement as required by Section 170 of the Act and 10 C. F. R. Part 140, upon a finding that the facility authorized has been constructed in conformity with the application as amended and in conformity with the provisions of the Act and the rules

[6893]

and regulations of the Commission, and upon a further finding, after conclusion of additional proceedings, if they be necessary or appropriate, of reasonable assurance of safety of operation, the Commission will consider the issuance of a license to PRDC pursuant to Section 104(b) of the Act, which license will, if issued, expire August 4, 1981.

Pursuant to Section 50.50 of the regulations in Title 10, Chapter 1, C. F. R., Part 50, the Commission has allocated to PRDC for use in connection with the reactor, 3,117.35 kilograms of uranium-235 contained in uranium at the isotopic ratios specified in PRDC's application for the license. Estimated schedules of special nuclear material transfers to PRDC and returns to the Commission are contained in Appendix "A" which is attached hereto. Shipments by the Commission to PRDC in accordance with column 2 of Appendix "A" will be conditioned upon PRDC's return to the Commission of material substantially in accordance with column 3 of Appendix "A".

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APPENDIX "A"

TO

POWER REACTOR DEVELOPMENT COMPANY

CONSTRUCTION PERMIT

Estimated Schedule of Transfers of Special Nuclear Material from the Commission to PRDC and to the Commission from PRDC:

(1) Date of Transfer (Calendar Year)	(2) Transfers from AEC to PRDC Kgs. U-235	Returns by PRDC to AEC Kilograms U-235 Recoverable Scrap	Returns by PRDC to AEC Kilograms U-235 Spent Fuel	Net Yearly Distribution Kgs. U-235	Cumulative Distribution Kgs. U-235
1958	673.19	134.57	—	538.62	538.62
1959	—	—	—	—	—
1960	436.43	87.21	—	349.22	887.84
1961	969.03	193.64	572.29	203.10	1,090.94
1962	887.65	177.39	795.45	(85.19)	1,005.75
1963	1,346.30	269.06	765.88	311.36	1,317.11
1964	1,409.59	221.75	915.95	(28.11)	1,289.00
1965	1,050.41	209.93	758.61	81.87	1,370.87
1966	1,257.53	231.32	780.88	225.33	1,596.20
1967	909.85	181.82	735.77	(7.74)	1,588.46
1968	1,109.59	221.75	778.03	109.81	1,698.27
1969	1,331.48	266.09	839.00	226.39	1,924.66
1970	1,139.18	227.66	838.43	73.09	1,997.75
1971	1,109.59	221.75	776.47	111.37	2,109.12
1972	1,272.32	254.26	776.90	241.16	2,350.28
1973	1,198.34	239.49	890.32	68.53	2,418.81
1974	1,257.53	251.32	781.39	224.82	2,643.63
1975	1,124.36	224.69	735.45	164.22	2,807.85
1976	1,198.34	239.49	839.01	119.84	2,927.69
1977	1,168.78	233.58	776.55	158.65	3,086.34
1978	1,139.18	227.66	955.33	(43.81)	3,042.53
1979	1,257.53	251.32	931.39	74.82	3,117.35
1980	909.85	181.82	735.64	(7.61)	3,109.74
1981	—	—	471.09	(471.09)	2,638.65
	23,856.05	4,767.57	16,449.83	2,638.65	

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Commission's Opinion, Final Decision and Order, May 26, 1959.

UNITED STATES OF AMERICA
ATOMIC ENERGY COMMISSION

In the Matter
of
POWER REACTOR DEVELOPMENT COMPANY.

Docket No. F-16.

OPINION AND FINAL DECISION.

This matter comes before the Commission for final decision pursuant to the Atomic Energy Act of 1954,[1] as amended, the Administrative Procedure Act of 1946,[2] and the Commission's Rules of Practice.[3] Exceptions to our Opinion and Initial Decision dated December 10, 1958, were filed by three unions (herein called Intervenors), and these Intervenors and the other parties to the proceeding have filed extensive briefs with the Commission.

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[1] 42 U. S. C. § 2011 *et seq.*

[2] Section 8, 5 U. S. C. § 1007. Section 181 of the Atomic Energy Act, 42 U. S. C. § 2231, makes the provisions of the Administrative Procedure Act applicable to "all agency action" taken under the Atomic Energy Act of 1954.

[3] 10 C. F. R. § 2.754, implementing Section 8(b) of the Administrative Procedure Act, provides in relevant part:

"(a) Upon submission of a case to the Commission for final decision, the Commission will normally consider the whole record. * * *

"(b) The final decision shall be in writing and shall contain:

(1) A statement of findings and conclusions, with the reasons or basis therefor, upon all the material issues of fact, law, or discretion presented;

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As in the case of our initial decision, the precise question now before the Commission is whether a provisional construction permit issued to Power Reactor Development Company (PRDC) on August 4, 1956, should be continued, modified, suspended, rejected or otherwise disposed of. The principal arguments made by the Intervenors are that the Commission illegally issued the conditional construction permit and that the alleged illegal issuance of the construction permit, and our refusal to suspend it, so vitiated the entire course of the proceeding as to deny them due process and a fair hearing.

In their exceptions and supporting brief the Intervenors have requested the Commission to reexamine all of the prior briefs and arguments in the proceeding, and for this reason we have felt obliged to broaden the scope of review in our consideration of a final decision. Because of this fact and because of the importance of this case as the initial construction permit proceeding before the Commission, our Opinion and Final Decision deal in detail with all such issues, and we amplify and affirm our Opinion and Initial Decision dated December 10, 1958.

As we set forth in detail in our Opinion and Initial Decision, the Intervenors, as well as all other parties, have been accorded every procedural safeguard consistent with the

[3] (Cont'd) (2) All facts officially noticed * * *, relied upon in this decision;
(3) The ruling on each relevant and material exception filed;
(4) The appropriate rule, order, sanction, relief, or denial thereof, with the effective date."

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prompt and expeditious disposition of an adjudicatory proceeding. On four separate occasions we have issued orders and memoranda with respect to the conduct of the proceeding,[4] and numerous pleadings and motions have been filed by the Intervenors and other parties herein to which we have given careful consideration.

The original conditional construction permit was issued by the Commission on August 4, 1956, and the Intervenors intervened in this proceeding on August 31, 1956. The hearing did not commence until January 8, 1957, and then only after informal and formal prehearing conferences. The hearing lasted with intermittent recesses until August 7, 1957. In accordance with our original order for hearing, the Hearing Examiner certified the record to us for initial decision, and the case was argued orally before the Commission on May 29, 1958.

[4] Order and Memorandum October 8, 1956, 6 Ad. L. 2d 549, dealing with conduct of hearing and issues therein; Order and Memorandum December 21, 1956, dealing with request for reconsideration of October 8, 1956, order and other matters; Order and Memorandum February 28, 1957, denying interlocutory appeal from order and ruling of Hearing Examiner on permissive use of narrative testimony; and Order March 5, 1957, 6 Ad. L. 2d 891, denying motion for access to Restricted Data without security clearance. Subsequent to our Opinion and Initial Decision, on February 3, 1959, we refused to accept for filing certain "Exceptions" dated December 19 and 22, 1958, and tendered by Elliot Earl, of Manchester, Conn., who had been permitted to participate in the proceeding on a limited basis pursuant to 10 C. F. R. § 2.731. The "Exceptions" were accepted for filing as a supplement to the "Statement of Position" filed by Mr. Earl. Statements of position requesting that the provisional construction permit be suspended were received from the AFL-CIO and Cooperative League of America, which also made limited appearances. The State of Michigan, which had been permitted to intervene in the proceeding, filed a statement taking no firm position with respect to the merits of the proceeding but emphasizing its responsibility for the health, safety, and welfare of its citizens.

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Aside from the Application and its exhibits aggregating about 1200 pages, the record of hearing comprises ap-

proximately 5100 pages of other exhibits, narrative testimony, and transcript. AEC went to extraordinary lengths to make both its officers and its consultants available as witnesses at the hearing. Of the 17 witnesses who testified, 12 were connected with the Commission in either an official or consulting capacity, and all of the Intervenors' four witnesses were connected with the AEC. No resistance was interposed to subpoenas issued to any of these witnesses.

Significantly, Intervenors failed to except to our finding and provision for procedure for continuing review of the PRDC project, although they did claim that our order was "erroneous" without any explanation of the grounds therefor. Effective upon issuance of the initial decision, this procedure was established in the public interest and that of the Intervenors. It requires both PRDC and the separated staff of AEC, and permits the Intervenors, to submit to all participants in the proceeding data coming to the attention of any one of them pertinent to safety in construction, design, and operating characteristics of fast breeder reactors similar or identical to the PRDC project. Under this procedure we are enabled, on the record, to consider new information material to the project and to provide for a further hearing in the matter, if deemed desirable prior to the final operating license proceeding.

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Pursuant to this procedure, on March 9, 1959, PRDC filed with the Commission its "First Quarterly Technical Report" dated March 6, 1959, together with 13 exhibits. On the same date the separated AEC staff filed with the

Commission its first "Report by AEC staff on Fast Breeder Reactor Safety Data," together with 36 reports and documents. On April 2, 1959, PRDC filed with the Commission its "First Semiannual Report of Power Reactor Development Company as of December 31, 1958", dated March 27, 1959. Copies of all the above reports and documents have been filed with the parties in the proceeding and are available to the public in the Commission's Public Document Room. Since the above reports and documents have not been formally presented on the record by any party, subject to cross examination, we have taken no notice of the matter contained therein in this Opinion and Final Decision.

As more particularly hereinafter set forth, we find that none of the exceptions taken by the Intervenors are supported in the whole record or in law. Further, we find that none of the procedural errors alleged by the Intervenors have in fact denied the Intervenors a fair hearing, and there has been no substantial prejudice to the Intervenors or any injury to the public interest as a result of these proceedings. As we made clear in our initial decision, the prime concern of the Commission is that the proposed reactor be constructed and operated without undue hazard to the public health and safety. As Intervenors concede, no hazard

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whatsoever is involved in the construction of the project. Before we authorize the issuance of an operating license to PRDC at a further reopening of this proceeding, we will require that all safety questions be answered to our

complete satisfaction, as required by the statute and our regulations. Under such circumstances, the public interest and that of the Intervenors have been protected.

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I. Statutes and Regulations

This proceeding requires us, for the first time in an adjudication, to construe and apply several provisions of the Atomic Energy Act of 1954 and our own regulations which relate to the issuance of construction permits and licenses for power reactors. Intervenors attack our construction of the relevant statutory and rule provisions, as set forth in our initial decision, principally on the grounds that (1) "[i]t appears to be the view of the Commission that there are no established standards governing the issuance of construction permits and . . . the Commission has, in effect, uncontrolled discretion in the granting of such permits", and (2) our decision "simply sweeps aside any limitations imposed by" the statute and our regulations.[5] Closely allied with these contentions is the position of Intervenors that the same findings, with respect to safety and financial qualification, for issuance of an operating license are necessary for issuance of a provisional construction permit. For the reasons hereafter set forth, we must reject these arguments.

[5] Intervenors' Exceptions to Opinion and Initial Decision, with Supporting Brief, pp. 9-11.

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1. *Statute*

Congress, in the Atomic Energy Act of 1954, provided for two types of licenses with respect to the development

and production of electric power. The Section 103[6] class of license for

[6] 42 U. S. C. § 2133, "Commercial Licenses", which provides, in pertinent part:

"a. Subsequent to a finding by the Commission as required in section 102, the Commission may issue licenses to transfer or receive in interstate commerce, manufacture, produce, transfer, acquire, possess, [or] use, . . . such type of utilization or production facility. Such licenses shall be issued in accordance with the provisions of chapter 16 and subject to such conditions as the Commission may by rule or regulation establish to effectuate the purposes and provisions of this Act.

"b. The Commission shall issue such licenses on a non-exclusive basis to persons applying therefor (1) whose proposed activities will serve a useful purpose proportionate to the quantities of special nuclear material or source material to be utilized; (2) who are equipped to observe and who agree to observe such safety standards to protect health and to minimize danger to life or property as the Commission may by rule establish; and (3) who agree to make available to the Commission such technical information and data concerning activities under such licenses as the Commission may determine necessary to promote the common defense and security and to protect the health and safety of the public. All such information may be used by the Commission only for the purposes of the common defense and security and to protect the health and safety of the public.

"c. Each such license shall be issued for a specified period as determined by the Commission, depending on the type of activity to be licensed, but not exceeding forty years, and may be renewed upon the expiration of such period.

"d. No license under this section may be given to any person for activities which are not under or within the jurisdiction of the United States, . . . No license may be issued to an alien or any corporation or other entity if the Commission knows or has reason to believe it is owned, controlled, or dominated by an alien, a foreign corporation, or a foreign government. In any event, no license may be issued to any person within the United States if, in the opinion of the Commission, the issuance of a license to such person would be inimical to the common defense and security or to the health and safety of the public."

operation of a power plant requires a finding that the proposed utilization[7] or production facility[8] has been sufficiently developed to be of practical value for industrial or commercial purposes. In addition to the medical therapy provisions thereof[9] not pertinent to this proceeding, Section 104 of the statute provides for a reactor of a research and developmental character and envisions progress towards practical applications, as follows:

[1] Defined in Section 11aa(1) of the statute, 42 U. S. C. § 2014(aa)(1), to include, "any equipment or device, except an atomic weapon, determined by rule of the Commission to be capable of making use of special nuclear material in such quantity as to be of significance to the common defense and security, or in such manner as to affect the health and safety of the public, or peculiarly adapted for making use of atomic energy in such quantity as to be of significance to the common defense and security, or in such manner as to affect the health and safety of the public". 10 C. F. R. § 50.2(b) further defines a utilization facility as meaning "any nuclear reactor other than one designed or used primarily for the formation of plutonium or U-233".

[2] Defined in Section 11t(1), 42 U. S. C. § 2014(t)(1), as meaning "any equipment or device determined by rule of the Commission to be capable of the production of special nuclear material in such quantity as to be of significance to the common defense and security, or in such manner as to affect the health and safety of the public". 10 C. F. R. § 50.2(a)(1) further defines a production facility as, among other things, "any nuclear reactor designed or used primarily for the formation of plutonium or uranium 233".

[3] 42 U. S. C. § 2134, "Medical Therapy and Research and Development".

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"b. The Commission is authorized to issue licenses to persons applying therefor for utilization and production facilities involved in the conduct of research and development activities leading to the demonstration of the practical value of such facilities for industrial or commercial purposes. In issuing licenses under this subsection, the Commission shall impose the minimum amount of such regulations and terms of license as will permit the Commission to fulfill its obligations under this Act to promote the common defense and security and to protect the health and safety of the public and will be compatible with the regulations and terms of license which would apply in the event that a commercial license were later to be issued pursuant to section 103 for that type of facility. In issuing such licenses, priority shall be given to those activities which will, in the opinion of the Commission, lead to major advances in the application

of atomic energy for industrial or commercial purposes.

* * * * *

"d. No license under this section may be given to any person for activities which are not under or within the jurisdiction of the United States, ... * * * In any event, no license may be issued to any person within the United States if, in the opinion of the Commission, the issuance of a license to such person would be inimical to the common defense and security or to the health and safety of the public."

Once a finding of practical value can be made under Section 102[10] of the statute with respect to a reactor type licensed under

[10] 42 U. S. C. § 2132, "Finding of Practical Value," which provides: "Whenever the Commission has made a finding in writing that any type of utilization or production facility has been sufficiently developed to be of practical value for industrial or commercial purposes, the Commission may thereafter issue licenses for such type of facility pursuant to section 103." According to the Joint Committee on Atomic Energy, "[t]his finding [under Section 102] separates the issuance of research and development licenses for any facility under section 104b., and the issuance of commercial licenses under section 103," S. Rep. No. 1699, 83d Cong., 2d Sess. 19 (1954), 1 Legislative History of the Atomic Energy Act of 1954 767 (1955) (hereafter Leg. Hist.).

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Section 104, then the utilization facility involved would normally be licensed as a Section 103 commercial reactor.[11]

Section 182 of the statute[12] provides, among other things, for the submission of applications for licenses setting forth "such information as the Commission, by rule or regulation, may

[11] This scheme of licensing implements the purposes of the statute for "a program of conducting, assisting, and fostering research and development in order to encourage maxim scientific and industrial progress" and "a program to encourage widespread participation in the development and utilization of

atomic energy for peaceful purposes to the maximum extent consistent with the common defense and security and with the health and safety of the public". Sections 3a. and d., 42 U. S. C. §§ 2013(a) and (d). In line with these basic objectives, Sections 31-33 of the 1954 Act authorize and direct the Commission to conduct research and development and to foster and encourage the conduct of research and development by others, in fields related to the civilian uses of atomic energy, including "the demonstration of the practical value of utilization or production facilities for industrial or commercial purposes," 42 U. S. C. §§ 2051-2053.

[12] 42 U. S. C. § 2232, "License Applications," which reads, in pertinent part:

> "a. Each application for a license hereunder shall be in writing and shall specifically state such information as the Commission, by rule or regulation, may determine to be necessary to decide such of the technical and financial qualifications of the applicant, the character of the applicant, the citizenship of the applicant, or any other qualifications of the applicant as the Commission may deem appropriate for the license. In connection with applications for licenses to operate production or utilization facilities, the applicant shall state such technical specifications, including information of the amount, kind, and source of special nuclear material required, the place of the use, the specific characteristics of the facility, and such other information as the Commission may, by rule or regulation, deem necessary in order to enable it to find that the utilization or production of special nuclear material will be in accord with the common defense and security and will provide adequate protection to the health and safety of the public. Such technical specifications shall be a part of any license issued. The Commission may at any time after the filing of the original application, and before the expiration of the license, require further written statements in order to

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determine to be necessary to decide such of the technical and financial qualifications of the applicant, . . . or any other qualifications of the applicant as the Commission may deem

[12] (cont'd) enable the Commission to determine whether the application should be granted or denied or whether a license should be modified or revoked. All applications and statements shall be signed by the applicant or licensee. Applications for, and statements made in connection with, licenses under sections 103 and 104 shall be made under oath or affirmation. The Commission may require any other applications or statements to be made under oath or affirmation.

"b. The Advisory Committee on Reactor Safeguards shall review each application under section 103 or 104 b. for a license for a facility, any application under section 104 c. for a testing facility, and any application under section 104 a. or c. specifically referred to it by the Commission, and shall submit a report thereon, which shall be made part of the record of the application and available to the public, except to the extent that security classification prevents disclosure.

"c. The Commission shall not issue any license for a utilization or production facility for the generation of commercial power under section

103, until it has given notice in writing to such regulatory agency as may have jurisdiction over the rates and services of the proposed activity, to municipalities, private utilities, public bodies, and cooperatives within transmission distance authorized to engage in the distribution of electric energy and until it has published notice of such application once each week for four consecutive weeks in the Federal Register, and until four weeks after the last notice."

* * * *

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appropriate for the license." Under Section 183,[13] each license "shall be in such form and contain such terms and conditions as the Commission may, by rule or regulation, prescribe to effectuate the provisions of this Act." Sections 161b. and i.[14] generally authorize the Commission to promulgate rules in the performance of its functions.

The rules and regulations of the Commission with respect to the procedure for the granting, revocation, and suspension of licenses do not make a distinction between Section 103 and

[13] 42 U. S. C. § 2233, "Terms of Licenses," which provides:
"Each license shall be in such form and contain such terms and conditions as the Commission may, by rule or regulation, prescribe to effectuate the provisions of this Act, including the following provisions:
"a. Title to all special nuclear material utilized or produced by facilities pursuant to the license, shall at all times be in the United States.
"b. No right to the special nuclear material shall be conferred by the license except as defined by the license.
"c. Neither the license nor any right under the license shall be assigned or otherwise transferred in violation of the provisions of this Act.
"d. Every license issued under this Act shall be subject to the right of recapture or control reserved by section 108, and to all of the other provisions of this Act, now or hereafter in effect and to all valid rules and regulations of the Commission."

[14] 42 U. S. C. §§ 2201(b) and (i).

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Section 104 licenses. The substantive standards for the issuance of each such license type differ to some extent, because of the distinction which Congress has made between

the purposes of commercial and developmental licenses.[15] Under Section 185 of the Act,[16] ordinarily a construction permit must be issued prior to licensing under either Section 103 or Section 104. This section provides:

> "All applicants for licenses to construct or modify production or utilization facilities shall, if the application is otherwise acceptable to the Commission, be initially granted a construction permit. The construction permit shall state the earliest and latest date for the completion of the construction or modification. Unless the construction or modification of the facility is completed by the completion date, the construction permit shall expire, and all rights thereunder be forfeited, unless upon good cause shown, the Commission extends the completion date. Upon the completion of the construction or modification of the facility, upon the filing of any additional information needed to bring the original application up to date, and upon finding that the facility authorized has been constructed and will operate in conformity with the application as amended and in conformity with the provisions of this Act and of the rules and regulations of the Commission, and in the absence of any good cause being shown to the Commission why the granting of a license would not be in accordance with the provisions of this Act, the Commission shall thereupon issue a license to the applicant. For all other purposes of this Act, a construction permit is deemed to be a 'license'."

[15] For example, 10 C. F. R. § 50.41 provides "additional standards" for Section 104 licenses, and 10 C. F. R. §§ 50.42 and 50.43 provide "additional standards" for Section 103 licenses.

[16] 42 U. S. C. § 2235, "Construction Permits".

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The issuance of a construction permit is to be accorded the same procedural safeguards of hearing and notice to interested persons under Sections 182 and 189a.[17] of the statute as in the case of an operating license. Although Intervenors claim that the Commission may not consider the granting of a construction permit and the granting of a license as two separate proceedings subject to substantially different results,[18] that procedural similarity only was intended between permits and licenses is clearly indicated in the entire legislative history of Section 185.[19] In recognition of this point, our rules are designed to provide for Commission determination of the form and scope of a

[17] 42 U. S. C. § 2239(a), which provides:

"In any proceeding under this Act, for the granting, suspending, revoking, or amending of any license or construction permit, or application to transfer control, and in any proceedings for the issuance or modification of rules and regulations dealing with the activities of licensees, and in any proceeding for the payment of compensation, an award or royalties under sections 153, 157, 186 c., or 188, the Commission shall grant a hearing upon the request of any person whose interest may be affected by the proceeding, and shall admit any such person as a party to such proceeding. The Commission shall hold a hearing after thirty days' notice and publication once in the Federal Register on each application under section 103 or 104 b. for a license for a facility, and on any application under section 104 c. for a license for a testing facility."

[18] Post-Hearing Brief of Intervenors, pp. 18-19.

[19] On several occasions during Congressional consideration of the statute, Section 185 was sought to be amended by adding at the end thereof, "and no construction permit shall be issued by the Commission until after the completion of the procedures established by section 182 for the consideration of applications for licenses under this Act", 1 Leg. Hist. 1168, 1178, 1209. The proposed language appears to have had

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construction permit preliminary to a Section 104 license as

[19] (cont'd) its basis in a criticism of Section 185, as reported out by the Joint Committee, S. Rep. No. 1699, *supra* n. 10 at 84, 1 Leg. Hist. 832, and as

finally enacted, made by Representatives Price and Holifield, *ibid.* at 123, 1 Leg. Hist. 871: "Section 185, providing for the issuance of construction permits to applicants whose applications are otherwise satisfactory to the Commission, should be specifically *subject to the same procedural safeguards, assuring interested parties full opportunity for notice, hearings, and appeal before issuance, as are provided in connection with the issuance of licenses under section 182.* We believe that the section should be amended to make *the same procedure* specified in section 182 mandatory before construction permits are issued." (Emphasis added.) The same emphasis on procedural similarity between a construction permit and license was made by Representative Holifield in proposing the amendment on the House floor, 100 Cong. Rec. 10397-98 and 10406, III Leg. Hist. 2848-49 and 2857. However, the amendment was apparently never considered or voted upon by the House, see 100 Cong. Rec. 11368-72, III Leg. Hist. 2953-57. A similar amendment was presented on the floor of the Senate by Senator Humphrey, who stated that "at the time I drew up this amendment I was not aware of the modifications which had been made to section 182 and also to the judicial review section. . . . * * * [U]nder the terms of the bill, as amended, the construction permit is equivalent to a license. In other words, . . . under the bill a construction permit cannot be interpreted in any other way than being equal to or a part of the licensing procedure. * * *" (100 Cong. Rec. 11566, III Leg. Hist. 3759) Senator Hickenlooper, sponsor of the bill in the Senate, responded that (1), by virtue of certain amendments to Sections 182 and 189 providing for application of the Administrative Procedure Act and other procedural changes to both construction permits and licenses, the amendment was not essential and (2), in the words of Senator Humphrey, "the revised sections on judicial review and on hearings and the revised Section 182 on license application all apply directly to construction permits" (100 Cong. Rec. 11566, III Leg. Hist. 3759). Senator Hickenlooper was referring to an amendment to Section 189 which was approved on the floor of the Senate to provide for a formal hearing in proceedings involving the grant of a license or construction permit (100 Cong. Rec. 10171, III Leg. Hist. 3175); and subsections (b) and (c) of Section 182 (since 1957, subsections (c) and (d)), which were added by the Joint Committee to the Committee print of H. R. 8862, and S. 3323 dated May 21, 1954 (I Leg. Hist. 257, 330-31), incorporated in H. R. 9757 as introduced

appropriate in a particular case, depending upon the particular state of research and development currently available to the proposed project.

2. *Regulations*

Certain portions of our regulations have a bearing on the safety and financial issues in this case. The basic statement of the standards under which the Commission will issue both licenses and construction permits is Section 50.40 of our regulations.[20]

[20] (cont'd) June 30, 1954 (I Leg. Hist. 541, 625-27), and passed by the House (100 Cong. Rec. 11369, III Leg. Hist. 2954). The same end sought to be achieved by the Humphrey proposal was provided in the statute, as enacted, that is, a construction permit may only be issued upon public notice and hearing under the Administrative Procedure Act in the same manner as licenses are processed.

[21] 10 C. F. R. § 50.40, "Common Standards," which provides:

"In determining that a license will be issued to an applicant, the Commission will be guided by the following considerations:

"(a) The processes to be performed, the operating procedures, the facility and equipment, the use of the facility, and other technical specifications, or the proposals in regard to any of the foregoing collectively provide reasonable assurance that the applicant will comply with the regulations in this chapter, including the regulations in Part 20, and that the health and safety of the public will not be endangered.

"(b) The applicant is technically and financially qualified to engage in the proposed activities in accordance with the regulations in this chapter.

"(c) The issuance of a license to the applicant will not, in the opinion of the Commission, be inimical to the common defense and security or to the health and safety of the public."

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Under that regulation, where a construction permit for a developmental facility is involved, the Commission must be assured that (a) the *construction* of the facility will not endanger the health and safety of the public, (b) the applicant for the permit is technically and financially qualified to engage in the proposed *construction*, and (c) the issuance of the permit for *construction* will not involve acts inimical to the common defense and security or to the health and safety of the public.

Special standards for construction permits are provided in Section 50.45 of our regulations, which standards again emphasize that, under the statute, a construction permit is a step toward a license rather than the equivalent thereof.[21] Actual issuance of a construction permit, as well as of a license, is covered by Section 50.50.[22]

[22] 10 C. F. R. § 50.45, "Standards for Construction Permits," which provides: "An applicant for a license or an amendment of a license who proposes

to construct or alter a production or utilization facility will be initially granted a construction permit, if the application is in conformity with and acceptable under the criteria of §§ 50.31 through 50.38 and the standards of §§ 50.40 through 50.43."

[24] 10 C. F. R. § 50.50, "Issuance of Licenses and Construction Permits," which provides: "Upon determination that an application for a license meets the standards and requirements of the act and regulations, and that notifications, if any, to other agencies or bodies have been duly made, the Commission will issue a license, or if appropriate a construction permit, in such form and containing such conditions and limitations including technical specifications as it deems appropriate and necessary."

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Under Sections 50.23[23] and 50.56[24] the Commission will convert the permit to an operating license upon completion of construction, satisfaction of all the conditions of the permit, and "in the absence of good cause shown to the contrary." The regulation most vitally involved in the present proceeding is Section 50.35,[25] which provides:

> "*Extended Time for Providing Technical Information.* Where, because of the nature of a proposed project, an applicant is not in a position to supply initially all of the technical information otherwise required to complete the application, he shall indicate the reason, the items or kinds of information omitted, and the approximate times when such data will be produced. If the Commission is satisfied that it has information sufficient to provide reasonable assurance that a facility of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public and that the omitted information will be supplied, it may process the application and issue a construction permit on a provisional basis without the omitted information subject to its later production and an evaluation by the Commission that the final design provides reasonable

[24] 10 C. F. R. § 50.23, "Construction Permits," which provides, in pertinent part: "A construction permit for the construction of a production or utilization facility will be issued prior to the issuance of a license if the application is otherwise acceptable, and will be converted upon due completion of the facility and Commission action into a license as provided in § 50.56 . . ."

[26] 10 C. F. R. § 50.56, "Conversion of Construction Permit to License; or Amendment of License," which provides: "Upon completion of the construction or alteration of a facility, in compliance with the terms and conditions of the construction permit and subject to any necessary testing of the facility for health or safety purposes, the Commission will, in the absence of good cause shown to the contrary issue a license of the class for which the construction permit was issued or an appropriate amendment of the license, as the case may be."

[27] 10 C. F. R. § 50.35.

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assurance that the health and safety of the public will not be endangered."

3. *Application of Statute and Regulations*

The position of the Intervenors throughout this proceeding has been that issuance of the provisional construction permit to PRDC violated the Commission's own regulations and that, therefore, its issuance was illegal. This position was founded in large part on an interpretation of the statute and regulations to the effect that all the same findings as the Commission would have to make in order to issue a license must also be made in order to issue a construction permit.[28] In other words, the Intervenors maintain that, insofar as its factual foundation is concerned, the distinction between a construction permit and a license is only in the name, and that, unless there is sufficient foundation in the record now for the issuance of a license to operate, the construction permit should be suspended, and construction must stop. With this interpretation we cannot agree.

There can be no doubt that public safety is the first, last, and a permanent consideration in any decision on the is-

suance of a construction permit or a license to operate a nuclear facility.

[26] Although the Intervenors have excepted to this statement (Exception 2 and Supporting Brief, pp. 10-11; see Exceptions 3 and 8 and Supporting Brief, pp. 15-17), the record establishes that the Intervenors' argument left no other alternative (Post-Hearing Brief of Intervenors, pp. 16-17, 19, 42-43, and 59; Oral Argument, pp. 28-30). For example, the Intervenors argue that "the conditions of a construction permit should be the same as the conditions of an operating license" (Post-Hearing Brief, p. 17).

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As we emphasized in our initial decision, the Commission regards the importance of public safety so highly that it considers that it does not lose jurisdiction of this subject even after a license has been issued, at any stage in the course of its construction, or, for that matter, even after a facility is in operation.[27]

Section 185 of the 1954 statute clearly contemplates that not all the information necessary for issuance of an operating license is required for a construction permit. The section provides explicitly for the "filing of any additional information needed to bring the original application up to date" and for a determination by the Commission not only that the facility can be constructed and will operate in conformity with the application for the permit, but also that no good cause has been shown why the granting of a license would not be in accordance with the applicable provisions of the statute.

Read in conjunction with Section 104b., with its emphasis upon "the minimum amount" of regulation, and as administered under Commission rules, particularly Section 50.35, Section 185 clearly negates the synonymity of a provisional construction permit and a license to operate. The

very fact that the construction permit is referred to as the natural precursor of the license emphasizes the distinction between them, and

[27] See Act, Section 182a., 186a., 187, and 189a; 10 C. F. R. §§ 50.54(e),(f), (h), and (j) and 50.100.

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the distinction is well established in the systems of other administrative agencies.[28]

Everyone agrees, including the Intervenors,[29] that there is no hazard to the public in the construction of the reactor beyond that which is inherent in any other heavy construction. The only question of hazard to the public clearly arises when the time arrives for the reactor to go "critical" after issuance of an operating permit. The issue as seen by the Intervenors, however, is that construction of the reactor inevitably means its operation in this case. This contention is based on the arguments that the heavy investment in the reactor always will generate irresistible pressure for its operation so as to protect the investment itself, and that it would be unfair to PRDC to permit it to make a multi-million dollar investment and

[28] Compare Sections 309 and 319, Communications Act of 1952, 47 U. S. C. §§ 309 and 319. Section 319(c) provides that, in cases where a construction permit is required, the protest procedure would be applicable only to the issuance of the construction permit and not to the subsequent issuance of the license; see H. R. Rep. No. 1750, 82d Cong., 2d Sess. 11 (1952). There is some procedural analogy between an AEC provisional construction permit and a preliminary permit to be issued by the Federal Power Commission for proposed hydroelectric development, 16 U. S. C. §§ 797(f); see *Delaware River Development Corp.*, 10 F. P. C. 540, 542 (1951).

[29] Oral Argument, pp. 47-48; Post-Hearing Brief of Intervenors, p. 59.

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then deny it a license to operate. As the Intervenors see the problem, issuance of the license is always automatic—

virtually a ministerial act—once the provisional construction permit has been issued.

As we made clear in our initial decision, the Commission certainly does not so interpret the Act or its regulations. Indeed, proposals to so amend Section 185 as to achieve this result have conspicuously failed to influence the Congress.[30] Perhaps it may be argued that, in the case of small and relatively inexpensive research reactors of standard types, which have become virtually production line items, there is no great formal distinction between the first step construction permit and a second step licensing procedure. In each step there is the requirement of the Atomic Energy Act and the Administrative Procedure Act for a hearing on the record. Nevertheless, the experience of safety of these small research reactor, and the relatively minor consequences even if there were an accident, do not require the same degree of caution as is needed for a large, expensive, developmental power project such as that of PRDC.

[30] *Hearings Before Joint Committee on Atomic Energy on S. 3323 and H. R. 8862*, 83d Cong., 2d Sess. 113, 117-19, 226-27, II Leg. Hist. 1747, 1751-53, 1860-61 (1954). In recommending the deletion from Section 185 of the conditions precedent for issuance of an operating license after completion of construction under a permit, the Special Committee on Atomic Energy of the Association of the Bar of the City of New York stated, *ibid.* at 417, II Leg. Hist. 2051: "* * * Before granting a construction permit upon which a licensee may rely for the expenditure of substantial sums of money, the Commission should at the least determine whether the granting of a license would be in accordance with the provisions of the act. It is neither feasible nor fair for the Commission to postpone decision on so fundamental a question until after the work has been done and the money spent." The proposal has been put forward since passage of the statute, *Hearings Before Joint Committee on Atomic Energy on Development, Growth, and State of Atomic Energy Industry*, 84th Cong., 1st Sess. 258, 261 (1955).

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As we more fully discuss in Part II of this decision, PRDC has been on notice since before the first shovel of

dirt was moved that its construction permit is *provisional* upon further demonstration of many technological and financial facts, including the complete safety of the reactor. The Applicant has, in fact, stated on the record that it is going to proceed at first under only the construction permit so as to develop a background that will support assurance that the reactor can be operated in complete safety, and has stated its intention to seek operation authority only after all necessary facts have been assembled. Since PRDC has recognized the developmental nature of the reactor it is building and since it has expressly waived any commitment for an operating license[31] (if there exists any of the type that the Intervenors contend is implied by the construction permit), the possibility that the Commission would be in any way bound cannot be visualized. It would be hard to

[31] Acker Narr. Test. 11-12, 29; Gorman TR 3836-38; Oral Argument, pp. 82-83; Brief for Applicant, pp. 86-87. PRDC counsel stated in oral argument, p. 83: "* * * If the change in the reactor design should be so great that PRDC and its member companies should be unable financially to meet it, then the alternative is not that we ask you [the Commission] to let us finish the reactor and operate an unsafe reactor, but that then the project should be liquidated. We would feel that in such a case we would not have lost the so-called investment by a long shot. We would have acquired a great deal of additional knowledge in this field which would be extremely valuable for the development of other fast-breeder reactors."

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imagine a case where an applicant would be less able to argue that he had been misled by previous favorable Commission action. Under the circumstances of this case, moreover, and in view of the wording of the provisional construction permit, it is perfectly clear that PRDC is assuming a substantial financial risk with its eyes wide open, and that the generation of any pressure from such ingredients would be quite absurd.

An operating license may be considered in light of the clear wording of the statute and on the basis of the legislative history as a logical, but not an automatic, sequel to the fulfillment of the conditions of the construction permit. We again emphasize in this decision, however, the importance of the present construction permit provisions requiring the demonstration of safety and of satisfying those conditions.

Our interpretation of the 1954 Act and regulations promulgated thereunder with respect to provisional construction permits is based upon the statutory wording, the legislative history and purposes of that statute, and the practical problems of administration which the Congress clearly intended the Commission to resolve. This interpretation is neither novel nor illegal, as the Intervenors argue.

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Contemporaneously with promulgation of the rules contained in Part 50, Congress was fully informed of the reasons and basis for, as well as the intended method of, procedures for the issuance of provisional construction permits. The development of power reactors furnishes a clear example of the type of comparatively untried and technical field wherein importance should be accorded "a contemporaneous construction of a statute by the men charged with the responsibility of setting its machinery in motion, of making the parts work efficiently and smoothly while they are yet untried and new", *Norwegian Nitrogen Products Co. v. United States*, 288 U. S. 294, 315 (1933).[32]

Shortly before the rules contained in Part 50 of the Commission's regulations were finally promulgated, Mr. Harold L.

[32] See *United States v. American Trucking Association*, 310 U. S. 534, 549 (1940); *North Arlington National Bank v. Kearny Savings and Loan Assn.*, 187 F. 2d 564, 566 (3d Cir. 1951), *cert. denied*, 342 U. S. 816 (1951); *Peck v. Greyhound Corp.*, 97 F. Supp. 679, 680 (D. C. N. Y. 1951). We are not here construing our regulations to include what an administrator, exercising his delegated power, might have covered by regulation but did not, particularly where civil or criminal sanctions are being applied under the disputed regulations to the substantial prejudice of the persons regulated, *e.g., Cole v. Young*, 351 U. S. 536, 546-47 (1956); *Peters v. Hobby*, 349 U. S. 331, 344-45 (1955); *United States ex rel. Accardi v. Shaughnessy*, 347 U. S. 260, 267 (1954); *Tobin v. Wagner Co.*, 187 F. 2d 977, 979 (2d Cir. 1951).

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Price, Director of the then Division of Civilian Application,[33] describe to the Joint Committee on Atomic Energy the proposed regulations with respect to construction permits, as follows:[34]

"* * * The fact is that at the present stage of development, as you know, each of the reactors planned for construction is substantially unique. There are technical problems, hazards problems associated with each of these reactors on which answers have not yet been developed. This has made it impracticable for the Commission to prescribe in its regulations definitive standards relating to hazards evaluation. What we have done is to set up a procedure under which applicants can make their preliminary submissions to the Commission and then we would, so to speak, work along with them as fast as we are satisfied that the general design concept and the location of the facility appear to be all right. We would go ahead and issue a construction permit as the statute permits, which would have to be conditional, of course, conditioned upon their satisfying the various hazards problems that they will have to deal with.

"Very often this means that they have experimental and testing work to do. As fast as they complete that work and submit it to us, it can be approved and then the construction permit will mature into a license.

"The way the companies go about this, it is pretty clear that all of those matters will not finally be resolved until about the time the reactor is going into operation, because their designs will change, and they will run tests. But this will work out all right because, to the extent that the companies are satisfied that they can work out the answers to the hazards problems they develop, they are perfectly willing to go ahead with these conditional construction permits."

[34] The Division of Civilian Application has since been divided into a Division of Reactor Development and a Division of Licensing and Regulation, of which Mr. Price is the Director. Mr. Price was called as a witness in this proceeding by the Intervenors (TR 2833).

[35] *Hearings Before Joint Committee on Atomic Energy on Development, Growth, and State of Atomic Energy Industry*, 84th Cong., 2d Sess. 106 (1956).

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At the same hearings, Mr. Price discussed the development of standards for construction permits and licenses, in response to questions from the Joint Committee counsel:[35]

"Mr. Norris: * * *

"You have listed in your work different types of reactors for which licenses have been applied, that is the boiling water reactor and the breeder reactor. Have you given any thought to having separate regulations for parts of the regulatory processes for each of these types of reactors?

"Mr. Price: We thought about it, and for the time being rejected it primarily for this reason: We are unable to develop any definitive standards for hazards evaluation in detail for any of these reactors yet because the technology has not developed to the point where we know the hazards answers on all of these types

* *Ibid.* at 132-33. At that hearing the statement of the Commission to the Joint Committee also discussed the problems raised by the difficulty of developing detailed safety standards applicable to construction permits and licenses for power reactors, *ibid.* at 173: "First, in order to provide a basis for designing and operating atomic energy facilities and equipment, the Commission must establish the standards which will be applied in determining whether the public is being protected. * * * Second, in developing an adequate regulatory program, it is necessary to provide standards, guides, and codes under which proposed design and operating procedures may be evaluated as to their adequacy in preventing accidents and in minimizing the effects of those which may nevertheless occur. * * * The development of definitive standards or codes in this area will depend mainly on the standardization of the facilities themselves. The complex safety problems of nuclear reactors are unprecedented. At the present time, *each proposed reactor is different in its major aspects from any other reactor. It is evident that the safety requirements for each reactor must be considered on an individual basis. It is possible now to develop only very general standards and guides for reactor safety.*" (Emphasis added.)

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of reactors. We figure that in this developmental period the hazards evaluation business, which is really the chief licensing problem, is going to be handled, or will have to be handled pretty much on a case-by-case basis under some general standards which, of course, we do have. We really would not add anything to the value of the regulations or the procedure except length if we tried to spell out something separate for each type at the present time.

"Mr. Norris: Do you anticipate doing it in the future?

"Mr. Price: As the reactors are developed and prove out, and we begin to get standards in the sense of people wanting to build copies of them, then we will be at the point where we ought to consider doing that. Then we will have some definitive answers on the major hazards problems, and we will be able to spell out for each type of reactor what the basic hazards protection has to be. I do not believe it will be helpful to try to do it now.

"Mr. Norris: I would think that *if you waited until you were reaching a carbon-copy stage you would be waiting until you were almost reaching a stage when reactors might be found to be of practical value.*

"Mr. Price: *That could very well be.*" (Emphasis added.)

A more detailed description of the provisional construction permit procedure, and the reasons therefor, was given to the Joint Committee on Atomic Energy in 1958 by Dr. C. Rogers McCullough, Chairman of the Advisory Committee on Reactor Safeguards (ACRS), who was called as a witness in this proceeding by the Intervenors,[36]

[36] At the time that he testified, Dr. McCullough also was Deputy Director for Hazards Evaluation of the Commission's Division of Civilian Application. With the creation of the ACRS on a statutory basis in 1957, Dr. McCullough has since served as Chairman of the Committee.

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The subject was introduced by Representative Holifield, who asked the following question of Dr. McCullough:[37]

"I am going to ask you, how can you give a license for the construction of a reactor which has never been

constructed before and be sure that you are granting a safe license. I will apply this specifically to the experiments which have been conducted on the fast breeder type of reactor, the EBR1 which melted down as the result of an incident. The EBR2 which will be quite a larger size reactor, but along the same general principles, and which will not be finished until 1960, upon which the PRDC reactor plans to have its engineering based when it comes to the reactor stage.

"How can you in advance of certain experimental work on the EBR2, the completion of it and the operation of it for at least a reasonable length of time, justify clearing the PRDC for a full-scale reactor such as is contemplated?"

The following exchange then occurred:

"Dr. McCullough: Let me try to respond to your question. *In the construction stage of a new type reactor*—and frankly, in all cases of large reactors I feel they are for all practical purposes new types—*it is impossible to give a construction permit which then can be guaranteed to be converted into an operating license in my view.*

"The dilemma is that persons wishing to construct a reactor would like to know, before they commit large sums of money to construct, that they can operate. This is a perfectly reasonable point of view. So we have a dilemma here that you can't resolve.

"Representative Holifield: It can be solved?

"Dr. McCullough: We think it can be solved.

[31] *Hearings Before Joint Committee on Atomic Energy on Development, Growth, and State of Atomic Energy Industry*, 85th Cong., 2d Sess. 120-22

(1958). Dr. McCullough also stated, *ibid.* at 112, that the ACRS "believes, in the present state of the reactor art, it is impossible to set up rigid or fixed criteria or definite standards because the exercise of judgment and flexibility is needed during the developmental era. Each case presents differences which must be resolved individually."

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"Representative Holifield: It can be solved except unless by prohibiting the large reactor until additional data is concerned is one way?

"Dr. McCullough: Yes.

* * *

"Representative Holifield: I do not bring it up from the standpoint of extending the argument, but from a *real concern of how we are going to get on with the industry if we assume a position of waiting until everything is proven. You cannot get along with the industry that way, it is obvious. So there has to be a calculated risk.* But I am hoping that in the consideration of this calculated risk which is taken that the Safety Advisory Committee will recommend, to the best of their ability, every safeguard possible to not just assume the risk without also saying that there may be a risk, and if there is a risk here, how can we direct the engineering so that a safeguard is built concurrently with the building of the risk.

"Dr. McCullough: *This is the way we have tried to solve this problem: To give a construction permit, pointing out the areas that require further work, and so in a sense it is a conditional permit.*

"May I say that the words 'construction permit' may have misled us in some respects here. *The construction*

permit, when you went to put an addition on your house, has the concept that you have a complete description of what you are going to do before you get the permit. The construction permit in this reactor business is not the same thing.

"Representative Holifield: *That is right.*

"Dr. McCullough: *So what we have tried to do in the case of large reactors is to try to do it step by step and keep informed each step of the way.* * * *

* * *

"Representative Holifield: Is it possible in the case of a reactor such as the PRDC for them to build certain parts of the reactor—I am not thinking about the building or foundations or the roof, but the reactor itself—when there is still a large area which is still in in the realm of the unknown?

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"Dr. McCullough: There are two ways of approaching this. They could hold up on certain of the controversial—I am speaking technically now and unknown features is a better word—and the other thing they could do, if, in their technical judgment, they feel it is worthwhile, is to construct the particular part, realizing they may have to redo it. It is their money and I guess they can make that choice." (Emphasis added.)

The issuance of a provisional construction permit to PRDC, which does not in any manner adversely affect the

health and safety of the public or that of the Intervenors, was effected pursuant to the regulatory scheme generally prescribed by the Congress in the Atomic Energy Act of 1954, as carried out under Commission rule. If the Commission had not adopted and used the procedure at issue in this proceeding, it would be disregarding the letter and spirit of the statute, applied to the practical problems of reactor development.

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II. Original Provisional Construction Permit

Intervenors contend that the Commission erred in failing to find (1) that the issuance of a provisional construction permit on August 4, 1956, was illegal because no reasonable assurance of safety and financial qualifications existed at that time, and (2) that the Intervenors were denied a fair hearing because proof of such claimed illegality was not permitted to be included as an issue in the proceeding. Closely allied with these contentions is the Intervenors' claim that the Commission erred in refusing to suspend the construction permit as requested by the Intervenors.

After notice of the filing of the PRDC application was published June 27, 1956,[38] the Commission on August 4, 1956, issued a conditional or provisional construction permit (CPPR4) for the proposed project, reserved nuclear materials for use in connection therewith, but took no action with respect to a license to operate the plant.[39] After finding that PRDC and its associated companies were technically qualified to design and construct the proposed re-

actor, our provisional construction permit provided, in part (pp. 2-3):

"D.(1) There are identified areas of uncertainty regarding the hazards potential of fast neutron breeder reactors that must be investigated and resolved. From the current state of the technology applicable to such reactors it can be reasonably inferred that there may be other areas of uncertainty not yet identified and requiring investigation and resolution. * * *

[38] 21 Fed. Reg. 4687.
[39] 21 Fed. Reg. 5974.

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"(2) On the basis of information presently available, the Commission believes that the problems relating to the safety of operation of the PRDC reactor will prove to be of a kind that can be satisfactorily resolved within a reasonable time. There is some doubt whether they can be resolved in time to meet the schedule proposed by PRDC in its application [then December 1959] and it may turn out that further investigation beyond the program of investigation outlined by PRDC in its application will be needed.

"E. Although PRDC has submitted evidence of a commitment from certain banks for a loan of $15,000,000 and has described its plan for obtaining additional financing from its member companies, the evidence submitted to date does not justify a finding with respect to the financial qualifications of PRDC and accordingly the continued effectiveness of this permit will be conditioned upon a further showing in this regard . . . ."

Among conditions of the construction permit were the requirements that PRDC "within twelve months . . . submits sufficient information relating to its financial resources to enable the Commission to make a finding that the Company has adequate financial resources to meet the requirements of the law and the regulations",[40] and that the Applicant submit a final Hazards Summary Report showing that "the final design [of the proposed plant] provides reasonable assurance . . . that the health and safety of the public will not be endangered by operation of the reactor in accordance with specified procedures."

The letter dated August 4, 1956, from the Director, Division of Civilian Application, to PRDC, stated, in pertinent part:

[40] Extended for an additional twelve months by action of the Commission August 1, 1957.

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"As specified in the construction permit, prior to taking action on the conversion of the construction permit to a license to operate the facility a final Hazards Summary Report must be submitted to AEC for evaluation and a determination that the reactor can, in fact, be operated without undue risk to the health and safety of the public.

"As stated in the construction permit the Commission believes that the safety problems associated with the reactor will prove to be of a kind which can be resolved within a reasonable time. The Commission regards the fast breeder program as a very important program and will use its best efforts to assist the com-

party to resolve these problems as completely and as quickly as possible. However, the Commission wants it to be clearly understood that in issuing this construction permit the emphasis is on the fact that it is a conditional one and that the Commission can make no commitment to convert the permit to a license until it is satisfied on all safety matters.

"Also, as you are aware, PRDC has not submitted to date sufficient information for the Commission to make a finding with respect to financial qualifications. Paragraph 3d of the permit contains a condition that its continued effectiveness will be dependent upon a showing within 12 months by PRDC that its financial resources are such as to enable the Commission to make the required finding, unless for good cause shown the Commission extends the time for submission of such data."

In our Order and Memorandum dated October 8, 1956, we designated certain issues for determination and denied the Intervenors' request for suspension of the provisional construction permit "without prejudice to ultimate determination by the Commission as to whether the permit should be continued, modified, or vacated." The issues for hearing, now relevant, concerned (A) (1) whether there was information sufficient to provide reasonable assurance that the type of facility proposed

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could be constructed and operated at the location proposed without undue risk to health and safety of the public, and (2) whether there was reasonable assurance that technical

information required to complete the application would be supplied; (B) whether the applicant was financially qualified to engage in the proposed activities and to receive an allocation of special nuclear material; and (D) what additional or different provisions, if any, should be incorporated in the permit.

In an order dated December 21, 1956, we also denied, among other things, a motion by the Intervenors to expand the issues for hearing to include the alleged illegality of the original issuance of the provisional construction permit. We construed the Intervenors' pleadings "as denials that there is presently a sufficiency of facts or information warranting issuance of the construction permit" and as raising questions of law to be considered by the Commission on brief after conclusion of the hearing.

As we have previously stated, this proceeding was not complete until opportunities for hearing had expired or, if, as here, a hearing was properly requested and allowed, such hearing was held. Although the Commission believed at the time it issued the original provisional permit that reasonable assurance of safety and financial qualifications had been or would be established, this belief was immaterial once the request for hearing was made, and safety and financial qualifications became

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an issue for the proceeding on the record. Even if the Commission had erred in issuing the original construction permit, such error would not be prejudicial to the Intervenors, because they were afforded every opportunity on the record to develop the safety and financial issues.

Intervenors contend that such alleged error, per se, vitiated the entire course of the proceeding. Such a rule, we believe, was never contemplated by Congress in providing for construction permit and licensing proceedings under the Atomic Energy Act of 1954, would have undesirable results, and would be contrary to the public interest, where such interest is adequately protected by the proceeding here involved. In any such proceeding the public interest in obtaining reasonable assurance of safety and financial qualifications without undue hazard to the public, not the original granting of the permit, is the primary issue in the proceeding.[41]

Whether or not to suspend a construction permit pending the hearing or at the conclusion thereof was a matter exclusively within the discretion of the Commission, so long as the public interest and that of the Intervenors were not directly and

[41] *Federal Communications Commission v. Sanders Brothers Radio Station*, 309 U. S. 470, 477 (1940); *National Labor Relations Board v. National Container Corp.*, 211 F. 2d 525, 531-37 (2d Cir. 1954); *N. L. R. B. v. Monsanto Chemical Co.*, 205 F. 2d 763, 764-65 (8th Cir. 1953); *Todd v. Federal Trade Commission*, 145 F. 2d 858 (D. C. Cir. 1944); see *Clarksburg Publishing Co. v. F. C. C.*, 225 F. 2d 511, 515 (D. C. Cir. 1955).

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adversely affected by the exercise of that discretion. No one, not even the Intervenors, contends that going forward with the construction of this project will result in any risk whatsoever to the health and safety of the public. We have balanced the possibly conflicting considerations between continuation of the construction of the project and suspension thereof. We believe the public interest in the development of the fast breeder reactor, the time to be saved in

proceeding with construction while the remaining technical and safety problems are being solved, and our responsibilities under the Atomic Energy Act of 1954 are better served by continuing the permit.[42]

[42] *Federal Communications Commission v. WJR*, 337 U. S. 265, 275-76 (1949); *Federal Broadcasting System v. F. C. C.*, 239 F. 2d 941, 944 (D. C. Cir. 1956); *Indiana-Ohio Local Service Case*, 2 Ad. L. 2d 827, 828 (C. A. B. 1952); see *Radio Corp. of America v. United States*, 341 U. S. 412, 419-20 (1951); *Mid-Florida Radio Corp. v. F. C. C.*, 248 F. 2d 755 (D. C. Cir. 1957).

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III. Safety and Financial Issues

The vast majority of Intervenors' exceptions concern our findings in the initial decision with respect to safety and financial qualification. The principal factual issue in this proceeding is whether there is information sufficient to provide a reasonable assurance that a utilization facility of the general type proposed in the PRDC application can be constructed and operated at the location proposed therein without undue risk to the health and safety of the public. Subsidiary to this issue is whether there is reasonable assurance that technical information omitted from, and required to complete, the application will be supplied before issuance of an operating license. A careful evaluation of the entire record in this proceeding can only lead to an affirmative answer to all of these questions.

Many of the exceptions taken by the Intervenors to our findings and conclusions in the initial decision, particularly with respect to safety, rely upon isolated statements in the record by the experts who testified, which statements, if compared with all of the testimony of those and other witnesses, do not support the exceptions. Our decision

must be based on the substantial evidence in the record as a whole.[43] Even assuming

[43] *Federal Communications Commission v. Allentown Broadcasting Corp.*, 349 U. S. 358, 363-64 (1955); *National Labor Relations Board v. Injection Molding Co.*, 211 F. 2d 59 (8th Cir. 1954); see *Universal Camera Corp. v. N. L. R. B.*, 340 U. S. 474, 488-91 (1951).

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that conflicts in the testimony of the experts do exist, we must resolve such differences by an examination of all of the testimony and exhibits, particularly where the matters in dispute involve questions of expert judgment delegated by the Congress to the agency.[44]

1. *Description of Proposed Reactor*

The proposed reactor is the largest of this particular type so far proposed to be erected in the United States. The design of the facility includes a core of uranium, a blanket of uranium surrounding the core,[45] a reactor vessel housing the core and

[44] *Radio Corp. of America v. United States*, 341 U. S. 412, 419-20 (1951); *Market Street Ry. Co. v. Railroad Commission*, 324 U. S. 548, 560-61 (1945); *State of New York v. United States*, 98 F. Supp. 855, 860 (D. C. N. Y. 1951), *aff'd*, 342 U. S. 882 (1951), *reh. denied*, 342 U. S. 911 (1952); *Steelco Stainless Steel, Inc. v. Federal Trade Commission*, 187 F. 2d 693, 695-96 (7th Cir. 1951); *Consolidated Royal Chemical Corp. v. Federal Trade Commission*, 191 F. 2d 896, 899-900 (7th Cir. 1951); *Hamtramck Radio Corp.*, 1 Ad. L. 2d 448, 449 (F. C. C. 1951).

[45] The core of the reactor is to be a cylinder approximately 30.5 inches in diameter by 31.2 inches high, consisting of uranium pins 27% enriched in the isotope U-235, clad in zirconium and held in square, stainless steel subassemblies. A blanket of uranium depleted in the isotope U-235 would surround this core and would comprise, with the core, a cylinder 78.5 inches in diameter and 67 inches long.

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blanket,[46] movable control rods,[47] primary sodium and secondary coolant systems,[48] biological shielding,[49] a vapor

containment shell, and various associated structures for such purposes as storage of new and spent fuel elements, waste storage, clean-up

[28] The reactor vessel and core would be housed in a reactor building, which in turn would be housed in a containment structure, 120 feet high and 72 feet in diameter, of welded carbon steel. The reactor vessel is welded, stainless steel, with a maximum thickness of 2 inches, 36 feet high, with a diameter, enclosing the core and blanket, of 9.5 feet in the lower section and of 14.5 feet in the upper section.

[29] The safety and control mechanism for the reactor core includes rods containing Boron-10, which reduces radioactivity by absorbing neutrons. These rods control the radioactivity in the core by their insertion into or withdrawal from the core, and they are designed so that, in the event of a mechanical or electrical failure, their magnetic grips will release them to drop into the core.

[30] The reactor is designed to be cooled, by 5000 cubic feet of liquid sodium, pumped by electric pumps upward through core and blanket, thence through three primary coolant loops to heat exchangers, and then back to the reactor vessel. A secondary coolant system consisting of 3 loops carries liquid sodium from the primary heat exchangers to the steam generators, where the heat contained in the liquid sodium is used to convert water into steam. The liquid sodium then returns to the heat exchangers for further heating. This dual system is provided primarily to prevent the chemical reactions which would take place if the radioactive sodium in the primary system reached the water in the steam generator.

[31] For biological shielding, as well as for other purposes, the reactor vessel would contain twelve inches of stainless steel inside the lower portion thereof, thirty inches of borated graphite between the lower reactor vessel and the primary shield tank, and a 3.5 foot concrete wall enclosing the reactor vessel and primary coolant system. A 7-foot concrete wall and five feet of concrete and steel flooring would enclose the lower reactor compartment.

and storage of sodium and inert gas, general services, holding liquid wastes, drainage, breakwaters, and dikes.

Like all other contemporary power reactors, the fast breeder reactor is a device in which the energy of fission or uranium is converted into heat, which heat then is removed in such a way as to permit further conversion into electricity by means of conventional generator facilities.[32] This particular type of reactor is termed "fast" because it can utilize neutrons produced by the fissioning of Uranium-235 nuclei and moving at a speed of about 10,000 miles per

second.[31] If a reactor is so designed that its non-fissionable Uranium-238 atoms in the core and blanket capture neutrons and therefore change into plutonium atoms at a rate greater than the rate at which the Uranium-235 atoms are fissioning, it is called a "breeder". The proposed

[30] "The nuclear reactor is an assembly containing fissionable material in an arrangement designed to sustain and control a nuclear fission chain reaction. Fission occurs when a nucleus of a fissionable element [Uranium-233 and -235 and Plutonium-239] captures a subatomic particle called a neutron. The nucleus then splits into two lighter nuclei (the primary fission products) and at the same time energy is released, largely in the form of heat. Also, with the fission of each nucleus, neutrons are emitted, 2 or 3 on the average. If at least one of these is captured by another fissionable nucleus, a fission chain reaction, accompanied by the continuous production of heat, becomes possible." *Atomic Energy Facts* 79 (GPO 1957)

[31] If, however, the reactor employs as a "moderator", a material such as graphite, either ordinary or heavy water, or beryllium, which has the ability to slow down neutrons to a speed of about one mile per second without capturing those neutrons, and if the reactor employs those relatively slow moving nuclear particles in the chain reaction, it is called a slow or "thermal" reactor.

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PRDC reactor is so designed, and its conversion ratio is 1.20, or, in other words, it is designed to produce 20% more fissionable material than it consumes.

As in the case of any other power reactor at this stage of the art, in addition to the design features of the reactor which will be determined and demonstrated before the actual construction of the reactor, many other such features will be determined and demonstrated during its actual construction. This fact merely underlines the importance of the development of the first breeder reactor at an early date. As the Intervenors concede, the fast breeder reactor is one of the promising types for development of electric power on a commercially feasible basis. Demonstration of the economic practicability of breeding would increase by many times the available reserves of nuclear fuel by

facilitating the conversion into plutonium and use as fuel of the Uranium-238 isotope which comprises 99.3% of the natural uranium resources in the world.

2. *Safety of Proposed Reactor*

The concept of a fast breeder reactor is not novel. Government interest in fast neutron systems goes back to at least 1945.[52] In addition to applicant's proposed reactor, at

[52] At that time both the Argonne National Laboratory (then called the Argonne Forest Laboratory) and Los Alamos Scientific Laboratory submitted proposals to the Manhattan Engineering District (predecessor of the AEC) to design and construct one fast reactor by each laboratory. Both AEC and the United Kingdom have since then operated a number of small, uncooled critical assemblies and flexible critical experiments, and AEC has operated two fast reactors, "Clementine" (1946-52) and EBR I (1951-1955).

least two other breeder reactors are presently programmed by the AEC, one of which became operational in November 1957 (EBR I, Mark III core) and the other of which (EBR II) is scheduled for completion of construction in December 1959. The United Kingdom[53] was scheduled to complete construction of a uranium-fueled fast breeder reactor with a load capacity of 60,000 thermal kilowatts at Dounreay, Scotland, in December 1958.[54]

Three major problems relate to the operational safety of the fast breeder reactor. First, there is the possibility that such a reactor might have instabilities which could lead to a nuclear runaway. Second, there is the possibility that a fuel

[53] British data, including Dounreay data, is being and will continue to be made available to AEC pursuant to an agreement for exchange of detailed information under the U. S.-U. K. bilateral agreement.

[54] In addition to the foregoing reactors and critical experiments, general studies have been conducted, or are being undertaken, by AEC and APDA-PRDC in the areas of fuel element irradiation, sodium technology, theoretical and experimental analyses of meltdown problems, and containment calculations and experiments. There is considerable experience in the use of sodium and related materials as coolants. In general, contrary to Intervenors' exception, these sodium systems have operated successfully and have demonstrated the ability to achieve satisfactory purity of sodium and to avoid significant corrosion.

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meltdown resulting from a nuclear runaway or a failure of coolant could release energies capable of breaching the various containment layers.[55] Third, there is the possible damage resulting from the leak of radioactive fission products in the event of such breaching.

The possibility of one of these accidents—or some other not now foreseeable—cannot be categorically excluded. If the statute and the regulations are to be interpreted, as the Intervenors imply, so that the Commission must be *certain* that such an accident will never occur,[56] then no developmental reactor could ever

[55] Possibility of meltdown of the core of a fast breeder reactor arises because such reactors contain substantially more enriched U-235 then thermal reactors of equivalent power. Geometrically dispersed in the core to provide passage of coolant, which comprises nearly 50% by volume of the core, fissionable material, if assembled with sufficient rapidity, would explode. Although such an explosion would not have the force of an atomic bomb and in itself would not represent a hazard to people off the reactor site, the explosion conceivably could generate sufficient force to breach the various containment layers and thus release fission products to the atmosphere. Information presently available does not exclude the possibility that a meltdown and reassembly of the core could release energies capable of effecting such results. An extensive program to investigate further the possibility of a nuclear meltdown, the course which it would follow, and the energies which could result, as well as the further strengthening of the containment structures, has been undertaken by Applicant and the AEC.

[56] See, *e.g.*, Post-Hearing Brief of Intervenors, p. 42 ("the record does not demonstrate that there cannot be a meltdown of the PRDC reactor"), p. 43 ("possibility of simultaneous failure of both mechanical controls and human controls cannot be excluded") and p. 49 ("still uncertain that the proposed containment shell will not be breached in a meltdown").

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be built under a construction permit or operated under a license. The very fact that Section 104 of the Atomic Energy Act of 1954, under which developmental reactors can be licensed, is in the statute reveals that such a standard was never contemplated. As we emphasized in our initial decision, the concept of reasonable assurance of safety must be sensibly, though severely, applied.

The two types of instability which may be encountered in fast reactors—autocatalytic[37] and resonance[38]—are believed capable of handling by design features. Proposed experiments

[37] The stability of a reactor is essentially a matter of its power and temperature coefficients. If an increase in the temperature or power of the reactor tends to increase its reactivity—and hence increases its power—a vicious circle is created in which a power excursion, once started, tends to multiply itself. The reactivity of a reactor depends on its "multiplication factor", the number of nuclear fissions produced on the average by the neutrons resulting from one nuclear fission. If the multiplication factor (normally referred to as "k") is 1, the power is steady; if greater than 1, the power will decrease. The difference, k-1, is called the "reactivity" or sometimes the "excess reactivity" of the reactor. Reactivity is usually controlled by rods which can be moved in and out of the reactor, the rods either absorbing neutrons, cutting down the amount of fissionable fuel by removal of such fuel from the core, or permitting the escape of neutrons by moving the reflector. The terms "temperature coefficient", and "power coefficient" are used, respectively, to describe the effect on reactivity of changes of temperature and power. A positive temperature or power coefficient is one with which an increase in temperature or power produces an increase in reactivity, thereby causing a further increase in power. A negative coefficient is one with which an increase in temperature or power decreases reactivity and hence power. A reactor having significant positive temperature coefficients is termed autocatalytic. A reactor having suitable negative coefficients is considered inherently stable.

[38] Resonance may be defined as oscillations in power level which result from the interaction of slow and fast acting power coefficients. It is generally believed that resonance effects will be suppressed by substantial prompt negative power coefficients. Existence of such resonance effects does not present a safety hazard as serious as an autocatalytic effect.

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should determine whether or not bowing inward of fuel elements, thus increasing the density of the core and hence

reactivity, is responsible for a positive temperature coefficient in breeder reactors. It is highly probable—and the Intervenors do not dispute—that bowing can be prevented by proper mechanical design.

Apart from these problems, and as the Intervenors concede, fast reactors are generally considered to be as easy to control as thermal—or "slow"—reactors. Indeed, it is possible to operate a fast reactor with a relatively small amount of excess reactivity available, thereby ensuring that an accidental sudden withdrawal of all controls will not result in a dangerous nuclear runaway. PRDC proposes, at least during the early years of operation, to adhere to such a limitation of excess reactivity.

Contrary to the Intervenors' argument, the spectrum of expert testimony on the safety of the proposed PRDC design was surprisingly narrow. The report of the Advisory Committee on Reactor Safeguards[59] can be literally accepted by the Commission,

[59] The ACRS report is contained in a letter dated June 6, 1956, from Dr. McCullough, Chairman of the Committee, to the AEC General Manager. The conclusions of the report are:

"1. Even though there are no facts or calculations available to the Committee that clearly indicate that the proposed reactor is not safe for this site, the Committee believes there is insufficient information available at this time to give assurance that the PRDC reactor can be operated at this site without public hazard.

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as it was by many of the witnesses and the Intervenors, as meaning that the state of human knowledge at the time the report was prepared would not support an *absolute guarantee* that there would be no safety problem in the operation of the reactor. But it equally well permits the

conclusion that going forward with the construction phase of this project would, by the very nature of the information developed in the course of evolving design, help to remove doubt concerning safety and would tend to provide an increasingly firm foundation for the reasonable assurance required by the statute that the project could be *operated* without undue risk to public health and safety.

Witnesses for PRDC, employees of APDA, stated categorically not merely that the safety of the reactor type was fully established but that existing information, plus what would be

[9] (cont'd). "2. It appears doubtful that sufficient experimental information will be available in time to give assurance of safe operation of this reactor unless the present fast reactor program of the AEC is amplified and accelerated as detailed below.

"3. It is impossible to say whether or not an accelerated program would give sufficient information to permit safe operation of this reactor at the Lagoona Beach site on the time schedule presently proposed."

The report then recommends a program of investigation "to judge the safety of the proposed operation."

learned from start-up tests on the PRDC reactor, constituted all the information necessary to establish that the specific reactor proposed could be safely operated. According to Dr. Hans A. Bethe, Professor of Physics at Cornell University and APDA consultant (Narr. Test. 60-61):

> "By the application of theoretical physics to what we now know, it is my opinion that a fast breeder reactor of the general type proposed by PRDC can be constructed and operated in a populated community without undue risk to the public, and that it can be demonstrated, when such reactor has been built, that its operation is safe.
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". . . [I]t is my further opinion that such additional information will in fact show, with very high probability, that a reactor constructed in accordance with the present PRDC design can be safely operated. Even if the planned investigations should not demonstrate safety on the basis of the present design, they will at least substantially eliminate areas of uncertainty and point the way to changes in particular features of the design so as to assure safety. The design of the PRDC reactor is sufficiently flexible to accommodate such changes."

Although he was "not aware that there is sufficient evidence or information in the record of this hearing to permit a reactor of this general type to be operated today at this particular site", Dr. McCullough, ACRS Chairman, stated that "[i]f this experimental program is carried out in sufficient detail, I think it is very probable that the necessary information will be obtained" (TR 3006-07). Another ACRS member, Dr. Manson Benedict, Professor of Nuclear Engineering, Massachusetts Institute of Technology, expressed "guarded optimism" towards the PRDC project, with a

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belief in "a strong probability that the test programs, theoretical analyses and design studies described in the hearings will lead to a reactor which can be safely operated at this site" (Narr. Test. 16). An ACRS member, Dr. Harvey Brooks, Professor of Applied Physics and Dean of the Department of Engineering and Applied Physics, Harvard University, and Chairman of the ACRS sub-

committee appointed to follow the progress on the design of the PRDC reactor, described his opinion as follows (Narr. Test. 38839):

> "In conclusion, I believe that in all probability a fast breeder reactor of the PRDC design can be operated in a populous location such as the proposed Lagoona Beach site without undue hazard to the health and safety of the public. I do not believe that the presently existing supporting data are sufficient to give us the kind of confidence we ought to have to permit a project of this magnitude to be operated. I do believe, however, that adequate theoretical and experimental programs are now under way or proposed to furnish the further information required and that, assuming adherence to the time schedules which have been testified to, such information should be available in time to meet the proposed PRDC time schedule. Accordingly, I feel that there is reasonable assurance that the technical information needed to complete the license application will be supplied, insofar as that information relates to the matters covered in my testimony. I further believe that, barring unanticipated surprises, the information which will be obtained by these programs, including the PRDC start-up procedure itself, will furnish reasonable assurance that the PRDC reactor can be operated at a site such as that proposed without undue hazard to the health and safety of the public."

Other members of the ACRS, as well as an expert witness from the AEC staff, testified to substantially the same effect.

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It is in the nature of reactor design, although certainly not unique to it, that many features remain to be designed and demonstrated after construction is begun—and indeed some features redesigned and replaced after operation is under way—but there is reasonable assurance in the record that the solution of such problems as remain can be effected. As the late Dr. Mark Mills, former Associate Director and Head of the Theoretical Division of the University of California Radiation Laboratory and member of the ACRS, stated, "Practically all advanced technological developments take place with a sort of combined construction and research and development and necessary dovetailing of these things and it seems to me that just how this is done really pretty much has to be left up to the people doing it" (TR 3278).[60] Based on this record, there is nothing in the PRDC design as presently contemplated that is known to be inherently and immediately dangerous, no insoluble problems are presently identified, and construction of a prototype is not required because of the experimental work being done or to be done on problems affecting a fast breeder reactor of the PRDC type. However, until the questions raised by the ACRS have been answered to the satisfaction of the Commission, there will be no license to operate the PRDC reactor.

It is enough for the purposes of the present proceeding (that is, for the issuance of a provisional construction permit),

[60] See also Bethe (Narr. Test. 11): "* * * The simultaneous pursuit of programs of research, development and construction has become standard in the fast-moving field of atomic energy and is necessary in order to keep abreast or ahead of our competitors. * * *"

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and for the satisfaction of the requirements of the statute and the regulations, that there be reasonable assurance that the reactor can be constructed and operated without undue risk to the health and safety of the public. We conclude that the present state of knowledge as described in the record gives; and the accident possibilities presented on the record do not negate, that assurance. We anticipate that the growth of present knowledge within a time reasonable in relation to the production schedule of the project will continue to strengthen the assurance.[61]

As we emphasized in our initial decision, the question of safety obviously cannot be considered without regard to proposed location.[62] This record establishes reasonable assurance that the likelihood of any breach of the containment shell which PRDC proposes, designed as it is to contain an explosive which is equivalent to 600 pounds of TNT, a limit beyond any known accident possibility in the reactor, is extremely remote. The possible consequences in the event of such a rupture should still

[61] Compare *Radio Corp. of America v. United States*, *supra* n. 42, 341 U. S. 427, wherein Justice Frankfurter, *dubitante*, stated, after challenging the Court's acceptance of the expert judgment of the F. C. C. that a compatible system of color television was not presently foreseeable and therefore the public interest required adoption of a non-compatible system: "Experience has made it axiomatic to eschew dogmatism in predicting the impossibility of important developments in the realms of science and technology. * * *"

[62] The proposed site is located on the shore of Lake Erie, about 30 miles from the center of Detroit, Michigan, 25 miles from the center of Toledo, Ohio, 7½ miles from Monroe, Michigan, and 10 miles from the Canadian border. The site is bordered on one side by water and provides an exclusion

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not be ignored; however. If the containment structure failed to hold the fission products as the result of a nuclear

accident, the consequences would depend on the meteorological conditions at the moment as well as upon the nature of the fission products released. This problem is, of course, not unique to either the PRDC reactor or to fast breeder reactors in general. It applies to all types of reactors.

The evidence of record with respect to site gives reasonable assurance that the site is satisfactory from structural and underground water flow standpoints. The meteorology of the site is complex, but no reason appears in the record for it to be disqualifying. The site makes possible extensive safeguards against the inadvertent release of liquid contaminants.

The record shows that the applicant is well aware of its problem and is attempting to take all reasonable steps not only to prevent accidents, but also to curtail the consequences of an accident if there should be one. Studies of weather, hydrology, geology, and similar problems have yielded considerable information and are still in progress. Although the data of these types are not yet complete or conclusive, the record gives reasonable assurance that safe operation of the reactor will be as likely in that location as in any other location. We anticipate that knowledge to be acquired will fortify that assurance.

[*] (cont'd) area on the land side with a minimum radius of 2900 feet. Population distribution for given radii from the site ranges from 175 people within one mile to 2 million people within 30 miles. During the summer months the population within 5 miles would be increased due to vacationing transients and crowded beaches.

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Pursuant to Section 50.34 (g) of the Commission's regulations, the Commission has invariably required, prior to

issuance of a license, that applicants must identify, and the Commission evaluate, the so-called "maximum credible accident", in order to determine whether the worst accident deemed credible can have hazardous consequences to the public.[63] A maximum credible accident is that combination of conditions the occurrence of which is considered credible and for which the consequences appear to be greater than those for any other credible accident. Although the maximum credible accident for the proposed reactor as presently designed has not yet been definitively established with respect to meltdown and the consequences of a breach of the containment structures, studies have been initiated which give reasonable assurance that such maximum credible accident will be identified and its consequences evaluated.

[63] 10 C. F. R. § 50.34(g): "Each application shall state the following technical information: * * * (g) An evaluation of the proposed measures and devices to prevent acts or accidents which would create radioactive hazards or to protect against the consequences should such acts or accidents occur".

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The degree of "reasonable assurance" with respect to safety that satisfies us in this case for purposes of the *provisional* construction permit would not be the same as we would require in considering the issuance of the *operating* license.[64] Even the Intervenors on oral argument seemed to acknowledge the differing degrees of certitude that the two situations would require.[65] We think that the form of our order adequately protects all participants in this proceeding, as well as the public interest, in providing for the filing and distribution of new information that will be examined in determining reasonable assurance

of safety when the time arrives for consideration of an operating license.

[65] Reasonable assurance means reasonable probability, established under the particular circumstances of the case in good faith and in the exercise of sound discretion and expert judgment, *Great Atlantic & Pacific Tea Co. v. Hughes*, 53 Ohio App. 255, 4 N. E. 2d 700, 705 (1935); see *Franklin Fire Insurance Co. v. Royal Mail Steam Packet Co.*, 54 F. 2d 807, 809 (D. C. N. Y. 1931); *American Brake Shoe & Foundry Co. v. N. Y. R. Co.*, 293 Fed. 612, 625 (D. C. N. Y. 1922); *Van Hook v. Southern California Waters Alliance*, 328 P. 2d 212, 220 (Cal. App. 1958); *Rexroth v. Holloway*, 45 Ind. App. 36, 90 N. E. 87, 88 (1909).

[66] Oral Argument, p. 31.

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3. *Financial Qualification*

The Commission's regulations implementing Sections 182 a. and 183 of the Atomic Energy Act of 1954 make financial qualification an explicit condition to the issuance of a construction permit and ultimately an operating license, both with respect to engaging in the proposed activities[66]

[66] 10 C. F. R. § 50.40(b), which states in pertinent part:

"In determining that a license [or construction permit] will be issued to an applicant, the Commission will be guided by the following considerations:

* * * * *

"(b) The applicant is technically and financially qualified to engage in the proposed activities in accordance with the regulations in this chapter."

10 C. F. R. § 50.33(f) requires that each application for a construction permit state "[t]he financial qualifications of the applicant to engage in the proposed activities in accordance with the regulations in this chapter. If the application is also for special nuclear material license pursuant to the regulations in Part 70 of this chapter, information should be included with respect to the applicant's financial qualifications to assume responsibility for the payment of Commission charges for special nuclear material." The latter requirement is covered by 10 C. F. R. § 70.23(e) which provides in pertinent part:

"A license application [for special nuclear material under Section 53 of the statute, 42 U. S. C. § 2073] will be approved if the Commission determines that:

* * * * *

"(e) Where the quantity of material requested, or the nature of the proposed activities are such as to require consideration of these factors by the Commission, that the applicant appears to be financially qualified to assume responsibility for the payment of Commission charges for use, consumption or loss

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and to receiving an allocation of special nuclear material.[67] With estimates of $44,020,000 for the cost of construction, pre-construction and test operation, PRDC has assets aggregating

[66] (cont'd) of special nuclear material and to engage in the proposed activities in accordance with the regulations in this part. If the allocation . . . of a substantial quantity of special nuclear material is requested, the application should demonstrate that the applicant appears to be financially able to undertake and carry out the proposed use of special nuclear material for a reasonable period of time;

[67] 10 C. F. R. §§ 50.60(b) and (c), which provide in pertinent part

"(b) The request for incorporation of . . . [provisions designating quantities of special nuclear material available for use by the facility] may be made simultaneously with the submission of an application for construction permit or facility license or at any time thereafter. Such request should be accompanied by at least the following information:

(1) The applicant's financial qualifications to assume responsibility for payment of Commission charges for the materials, and to undertake and carry out the proposed use of special nuclear material for a reasonable period of time;

. . . . .

"(c) A request for the incorporation in a construction permit or license of provisions designating the amount of special material available for use by the facility will be approved by the Commission if:

. . . . . .

(2) The applicant appears to be financially qualified to assume responsibility for the payment of Commission charges for the material and to undertake and carry out the proposed use of special nuclear material for a reasonable period of time."

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$49,448,000 or an excess of $5,428,000.[68] Applicant's fourteen public utility members[69] have combined equity assets of $2 billion. Based upon past compliance with their commitments, their assets, and stated willingness to continue to support PRDC,

[68] These assets consist of $27,448,000 in firm commitments for contributions from members of PRDC, the necessary regulatory approvals for which have either been obtained or waived by the contributors as not required by applicable law; $7,000,000 in firm commitments from APDA in the form of cash, services, and equipment; and $15,000,000 in long term bank loans, guaranteed by the 16 utility members of PRDC. As of July 1, 1957, $4,000,000 of the bank loans had

been taken down. The $7 million figure for APDA does not, however, reflect APDA's full financial contribution to the project, which is estimated at over $18 millions. This contribution indicates actual expenditures of $6,444,000 for the years 1954-1956 and budgeted expenditures of $7,818,115 for 1957-1959, in addition to the cost of the component test facility estimated at $4,131,700.

• Central Hudson Gas & Electric Corporation; The Cincinnati Gas & Electric Company; Potomac Electric Power Company; The Detroit Edison Company; Delaware Power & Light Company; Long Island Lighting Company; Rochester Gas and Electric Corporation; The Toledo Edison Company; Consumers Power Company; Columbus and Southern Ohio Electric Company; Philadelphia Electric Company; Southern Services, Inc., representing the Southern Company (Incorporated), Alabama Power Company; Georgia Power Company, Gulf Power Company, and Mississippi Power Company; Wisconsin Electric Power Company; and Iowa-Illinois Gas and Electric Company. Seven equipment manufacturers are also PRDC members: Burroughs Corporation; Combustion Engineering, Inc.; Fruehauf Trailer Company; Holley Carburetor Company; The Babcock & Wilcox Company; Westinghouse Electric Corporation; and Allis-Chalmers Manufacturing Company.

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there is reasonable assurance from the record that the member companies of PRDC will provide any additional funds, if necessary, to take care of adverse contingencies.[70]

We, of course, recognize that there is a likelihood of a cost overrun on construction and research and development in connection with the PRDC project.[71] However, we must reject again as unreasonable the contention of Intervenors that PRDC can show financial qualification only if it is prepared to meet, with cash or assets in hand, a 25 percent overrun for all conceivable contingencies.[72]

[70] *Columbia Empire Telecasters v. Federal Communications Commission*, 228 F. 2d 459, 460 (D. C. Cir. 1955); *Port Arthur College*, 14 R. R. 1234, 1249, 1254 (F. C. C. 1957); *Midland National Life Insurance Co.*, 4 R. R. 1269, 1294 (F. C. C. 1949); *Samoan Airlines Case, Reopened*, 18 C. A. B. 533, 538-39 (1954); *Parks Investigation Case*, 11 C. A. B. 779, 790-91 (1950); *Reopened Mississippi Valley and Southeastern States Cases*, 11 C. A. B. 979, 992-93 (1950). For cases in which applicants for C. A. B. certificates were found financially qualified because of the financial standing of their parent companies, which closely resembles the situation in this proceeding, see *American Export Airlines, Inc.*, 3 C. A. B. 294, 295, 297 (C. A. B. 1941); *Pan American Airways Co.*, 1 C. A. B. 118 (C. A. B. 1939); *South Pacific Air Lines, Inc.*, 17 C. A. B. 762, 769 (C. A. B. 1953).

[71] Increases averaging between 5 and 7.5% already have occurred on specific items being ordered by APDA for PRDC or on labor and material expenses incurred by PRDC itself. The most pessimistic comment concerning possible

overrun was that given by the Commission's Assistant Chief, Engineering Branch, Division of Construction and Supply, who stated that the original PRDC estimate for "the nuclear portion of the project will cost several million dollars more than the $32,400,000 estimated by PRDC" (Radley Narr. Test. 5-6), but who was not prepared to give any more definitive estimate of the overrun" (TR 3301-02).

[73] *Atlantic Coast Broadcasting Corp.*, 26 F. C. C. 222, 230 (1959); *Great Lakes Television, Inc.*, 11 R. R. 845, 847-49 (1954), 25 F. C. C. 470, 512 (1958); *Lredell Broadcasting Co.*, 13 R. R. 996, 1001-1002 (1957); *Southeastern Enterprises (WCLE)*, 12 R. R. 578, 580 (1955), 13 R. R. 139 (1957).

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Applicant has submitted a statement of source and application of cash covering 10 years of operation, but major elements of PRDC's operating costs and revenues are, and can only be, speculative. This is inevitable in a project to construct a reactor of an advanced type for the purpose of demonstrating the practical value of such a facility. Indeed, one of the purposes of the project is to ascertain costs and revenues in the operation of such a reactor.[73]

[73] The difficulties in connection with operating costs and revenues arise primarily with respect to matters controlled by AEC. As the only primary supplier and purchaser of plutonium, the Commission sets prices for the sale and buy-back of special nuclear material. We have guaranteed domestic plutonium prices until June 30, 1962, at $44.20 per gram and for one year thereafter at $30 per gram. The price to be paid to Applicant for reactor-produced plutonium after June 30, 1963, will depend on future Commission action, but we have announced that we expect "that the prices for plutonium will be reduced, as dictated by consideration of the value of the material for its intended use by the United States and giving such weight to the actual cost of producing the material as the Commission finds to be equitable, to a level based upon the fuel value of plutonium in commercial power reactor facilities" (22 Fed. Reg. 3985, June 6, 1957). Applicant estimates the sale price per gram at $30 after June 30, 1963. The AEC's present estimate of the fuel value of that isotope is $12 per gram, based on comparison with the Commission's charges for U-235. However, there is at present no experience with the use of plutonium as fuel, and it is uncertain what the fuel value will turn out to be ten years hence. PRDC's costs and revenues are also affected by other Commission prices and charges, particularly those for chemical processing, which are fixed until June 30, 1967, and fuel charges, which are not guaranteed.

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Intervenors would require, as one of the bases for financial qualification, that the applicant provide for, and have

available, resources, including binding legal commitments, for every conceivable contingency and for unanticipated events which may occur during the 25-year life of the proposed operating license.[74] Such construction of our statute and regulations is completely unrealistic, contrary to reasonable legal requirements for financial qualification,[75] and would make virtually impossible the construction of any developmental reactor.

[74] See particularly Post-Hearing Brief, pp. 50-57; Reply Brief, p. 30; Oral Argument, p. 49.

[75] *Southeastern Enterprises (WCLE), supra* n. 72, 12 R. R. 581, wherein the protestant claimed lack of financial qualification based "upon conclusionary arguments grounded on hypothetical situations and contingencies of the protestants' own making"; the F. C. C. later held, 13 R. R. 145 "* * * [T]here is a sufficient showing that the station can be constructed and its operation commenced, and that is all that we require. The concept of public interest is not so exacting that it demands a licensee capable of sustaining great losses for long periods and pledged to do so. Were this not so, it is doubtful that many of the standard broadcast stations now authorized could have passed this test. * * *" The concept of reasonable financial requirements is particularly applicable to projects involving "many novel innovations" in a field where there is little precedent and where Congress has directed the agency involved to foster development, *New York City Area Helicopter Service Case*, 15 C. A. B. 259, 264, 269-70 (1951).

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So far as the record shows, funds have been forthcoming from the members of PRDC on call, and there is no evidence to indicate this willingness to continue to support PRDC will cease. PRDC appears to be paying its bills, and its credit has not been indicated to be questionable.

It appears in the record that the utilities which have contributed to PRDC have so far had their payments allowed by the Commissions regulating them in their respective States as proper expenditures. All in all, the record shows that PRDC has assets available to it of nearly $49,500,000, and this sum seems to be substantial evidence upon which to base a conclusion of financial responsibility.

We believe that the financial history of PRDC and the financial standing of its members are such that the increases in cost feared by the Intervenors will be covered through the devices that PRDC has previously utilized. The Commission's regulations obviously do not require an applicant to have cash on hand to cover all possible contingencies of costs higher and revenues lower than estimates. On the basis of the financial estimates in the record, and even after making allowances for reasonable cost over-runs and revenue underruns, we are satisfied that the record establishes financial qualification to construct and operate the proposed reactor, to receive an allocation of nuclear materials, and to pay Commission charges and

prices therefor for at least a reasonable time after scheduled start-up of the reactor, and certainly through the middle of 1963.[76] The Intervenors' argument and the Applicant's not too strenuous disagreement that the project is likely to be a financial failure for the PRDC membership does not refute it within the framework of the issues of this proceeding.[77]

[76] *Saginaw Broadcasting Co. v. Federal Communications Commission*, 96 F. 2d 554, 562-63 (D. C. Cir. 1938): "* * * The question of financial qualification has at least two aspects: first, has the applicant enough resources to construct the station and to operate it for a brief period of time; and second, is there a reasonable likelihood of financial profit to be expected from the operation of the station, or are the applicant's personal resources such that he is able and willing to operate a station for a considerable period of time at a loss. * * *"; *The Enterprise Co.*, 9 R. R. 816, 818j-k (1954); *Brush-Moore Newspapers Inc.*, 11 R. R. 641, 658-59, 667 (1956); *Great Lakes Television Inc.*, *supra* n. 72, 11 R. R. 512; *Iredell Broadcasting Co.*, *supra* n. 72, 13 R. R. 1001; *Southeastern Enterprises (WCLE)*, *supra* n. 72, 13 R. R. 142, 144; see also *Frank D. Tefft Jr.*, 8 R. R. 179, 190 (1952).

[77] There is no question that "the first nuclear power plants will be uneconomic, regardless of design", statement of AEC Chairman, *Hearings Before Joint Committee on Atomic Energy on Development, Growth, and State of Atomic Energy Industry*, 84th Cong., 1st Sess. 6 (1955). The President of PRDC told

the Joint Committee at the same hearing, ". . . we must look upon the problem as a developmental one on which money must be spent for the ultimate results rather than for any expectation of immediate and direct financial return," *ibid.* at 228-29. In this connection, the *Report of the Panel on the Impact of the Peaceful Uses of Atomic Energy*, 84th Cong., 2d Sess. 37 (1956), stated: ". . . the prospects for profitable return on investment, at this stage of research and development, are admittedly not high. There are many risks uncommon to private industry which exist under the rules governing this stage of atomic-power development as set forth in law and as administered by the Commission."

[6996]

IV. Other Procedural Issues

In their exceptions Intervenors have raised several other issues involving a claimed denial of fair hearing or violation of our regulations. In our disposition of these issues earlier in these proceedings and by this final decision, we have been and are keenly aware of our responsibilities under the Atomic Energy Act and the Administrative Procedure Act that all parties be accorded due process in accordance with the letter and spirit of those statutes.[78] At the same time, however, even assuming the validity of any issues raised by the Intervenors in this case, the law does not require reversal of an initial decision or the remanding of a case to the Hearing Examiner unless the error complained of so affected the rights of the complainants as to constitute substantial prejudice and to deny them a fair hearing.[79]

[78] See Sen. Doc. No. 248, 79th Cong., 2d Sess. 217 (1947).

[79] *Dolcin Corp. v. Federal Trade Commission*, 219 F. 2d 742, 746, 748-49 (D. C. Cir. 1954), *rehearing denied*, 219 F. 2d 751 (1954), *cert. denied*, 348 U. S. 981 (1955); *Union Starch and Refining Co. v. National Labor Relations Board*, 186 F. 2d 1008, 1013 (7th Cir. 1951); *Olin Industries, Inc. v. N. L. R. B.*, 192 F. 2d 799 (5th Cir. 1951); *cf. Reilly v. Pinkus*, 338 U. S. 269, 275-77 (1949), involving substantial prejudice in a Post Office Department fraud order proceeding where the right to cross examination of expert witnesses while on the stand was seriously inhibited.

[6997]

1. *Permissive Use of Direct Narrative Testimony*

At the formal prehearing conference, on motion of the Applicant, the Hearing Examiner ordered that the parties would be permitted to present direct testimony in narrative form, with or without exhibits, for identification, subject to objection by other parties and ruling by the examiner thereon and to cross examination of the witnesses involved. The Intervenors contend that (1) no narrative testimony may be offered by any party in an AEC adjudicatory proceeding in place of oral testimony taken under oath, without the consent of all the parties to the proceeding, and (2) substantial prejudice was done to their right of cross examination of the witnesses who submitted narrative testimony because they could reach no conclusion concerning the veracity and credibility of the witnesses from direct examination.

Any lawyer who has participated in administrative hearings knows that there are two sides to the question of written direct testimony, but the complex technical and financial matters involved in this proceeding seem to us to make it an archetype of the arguments in favor of the written presentation of direct examination. No question whatsoever of "personal credibility evaluation" arises in this case.[89] The permissive order issued

[89] *Gamble-Skogmo, Inc. v. Federal Trade Commission*, 211 F. 2d 106, 112-14, 116-17 (8th Cir. 1954); *Attorney General's Manual on Administrative Procedure Act* 78 (1947).

[6998]

by the Hearing Examiner accords with the provisions of the Administrative Procedure Act[81] and our Rules of Prac-

tice,[82] particularly the authority granted by statute and regulation for the Hearing Examiner to regulate the course of a hearing.[83]

[82] Section 7(c), 5 U. S. C. § 1006(c); see Sen. Doc. No. 248, *supra* n. 78, at 30-31, 208, 269-71, and 364-65; *Report of Attorney General's Committee on Administrative Procedure*, Sen. Doc. No. 8, 77th Cong., 1st Sess. 69-70 (1941); *Study of AEC Procedures and Organization in the Licensing of Reactor Facilities*, 85th Cong., 1st Sess. 21-22 (Joint Comm. Print 1957).

[83] 10 C. F. R. § 2.740, "Prehearing conferences", which provides:

"(a) In order to provide opportunity for the settlement of a proceeding or any of the issues therein, or for agreement upon procedural and other matters, there may be held at any time prior to or during a hearing, upon due notice of the time and place given to all parties, such conferences of the parties as, in the discretion of the presiding officer, time, the nature of the proceeding, and the public interest may permit.

"(b) Action taken at a prehearing conference may be recorded for appropriate use at the hearing in the form of a written stipulation among the parties reciting the matters upon which there has been agreement. The stipulation shall be binding upon the parties thereto."

[83] 10 C. F. R. § 2.733(c), (f), (h) and (k) which are based upon Section 7(b) of the Administrative Procedure Act, 5 U. S. C. § 1006(b).

The procedure provided by our rules and used by the Hearing Examiner in this proceeding finds support in the rules of other agencies, agency decisions, and the studies of interested public groups.[84]

2. *Alleged "Warning" to AEC Consultants*

Intervenors except to our finding that they were not denied a fair hearing because certain consultants of the Commission, who might have been called as witnesses, were officially advised of a possible conflict of interest. Intervenors categorize this action as a "warning" and as "intimidating prospective witnesses for Intervenors."[85]

By letter to counsel for the Intervenors dated December 14, 1956, the Commission's Director of the Division of Civilian Application stated that (TR 1627-28):

"* * * Commission consultants have been advised that the Commission interposes no objection to their voluntary appearance on behalf of any party to a formal hearing of the Commission.

* * * *"

[86] *Argonaut Airways Corp.*, 3 Ad. L. 2d 709, 712-13 (C. A. B. 1953); F. P. C. Rule 1.20(h), 18 C. F. R. § 1.20(h); I. C. C. Rule 1.77, 49 C. F. R. § 1.77; C. A. B. Rule 302.24(b), 14 C. F. R. § 302.24(b); see, generally, *Final Report of the President's Conference on Administrative Procedure*, 13, 37-40, 66, 73, 80 (1955); Second Hoover Commission, *Report on Legal Services and Procedures* 68-71 (1955); Second Hoover Commission, *Task Force Report on Legal Services and Procedure*, 191, 199-201 (1955).

[87] Post-Hearing Brief of Intervenors, pp. 22, 25.

[7000]

"However, the Commission has advised its consultants that voluntary appearances might involve a conflict of interest in their activities as consultants with the Commission and that they may wish to consult private counsel in this respect."

To this letter counsel for the Intervenors responded that, among other things, the "Commission had gone far out of its ways to suggest the possibility of prosecution for violation of the conflict of interest laws."[86]

The Commission did not, and of course could not, threaten criminal prosecution of witnesses, although Commission consultants are required by statute to take cognizance of the conflict of interest laws of the United States.[87] Conflict of interest has a broader connotation than that which the Intervenors

[88] *Ibid.* at 23. In that brief, counsel also stated that Intervenors did not call any Commission consultants because they "were unwilling to subject them to retaliation by compelling them to testify under subpoena," *ibid.* at 25. At the hearing counsel also stated that he "had planned to call several of the witnesses he [AEC staff counsel] has named, but in view of the fact that he [AEC staff counsel] is going to call them I forewent my intention to call them" (TR 2698-99).

[57] Section 163 of the Atomic Energy Act of 1954, 42 U. S. C. § 2203, provides, in pertinent part: ". . . [T]he members of advisory boards . . . may serve as such without regard to the provisions of sections 281, 283, or 284 of Title 18 of the United States Code, *except insofar as such sections may prohibit any such member from receiving compensation in respect of any particular matter which directly involves the Commission or in which the Commission is directly interested.*" (Emphasis added.)

[7001]

would appear to acknowledge, and the regulations of the Commission with respect to personnel, including consultants, so provide.[58] We fail to find in the record evidence that Intervenors could not obtain expert witnesses[59] because of the Commission's reasonable and lawful concern with any appearance of conflict of interest.

[58] Sec. 4124-032 of the AEC Manual provides: "*Conflict of Interests.* Employees (including consultants and designees) shall avoid situations which require *or appear to require* a balancing of private interests or obligations against official duties." (Emphasis added.)

Sec. 4139-16 of the Manual provides: "*Conflict of Interests.* A consultant or designee should not be engaged in any case where it appears that his private activities and interests are inconsistent with services for AEC. In all cases where there is an actual or probable conflict, the contract instrument should not be executed. (See Chapter 4124, 'Conduct of employees.') At the time of the appointment of each consultant and designee, copies of AEC Manual Chapter 4124, 'Conduct of Employees,' and 4139, 'Employment of Consultants and Designees,' shall be transmitted to him and his attention shall be directed to the sections which deal with conflicts of interests." The standard forms of contract for employment of consultants and designees (AEC Manual Appendix 4139-071-A through D) require each consultant and designee to certify that insofar as he knows "there does not exist any actual or potential conflict between his private interest . . . and his services for the Commission," and that he will "raise with the Commission any question regarding possible conflict of interests which may arise" as a result of a change in either his private interests or his services for the Commission.

[59] Compare *Highway Express Inc., Extension—Dangerous Explosives*, 1 Ad. L. 2d 828 (I. C. C. 1951), in which an applicant for a certificate to, among other things, carry explosives for the military failed to present Government witnesses with respect to the need for such service. In reversing a recommendation by the hearing examiner that the certificate be granted, the Commission stated, in part (829-30):

[7002]

3. *Status of AEC Staff*

The Intervenors claim that they were denied a fair hearing as a result of the Hearing Examiner's refusal at

the commencement of the proceeding to require AEC staff counsel to state its position on the issues specified by the Commission for hearing. Although no grounds are given for this exception, the position of the Intervenors, as set forth in previous briefs, appears to be that (1) by being required to proceed with cross examination and rebuttal of PRDC and AEC witnesses, and with the presentation of their own case, without knowledge of the position of the AEC staff, Intervenors were denied a fair hearing; (2) the proceeding did not involve initial licensing, and the staff was required to take a position under the Commission's Rules of Practice; and (3) "the entire hearing in this case was vitiated by the fact that AEC participated fully in the hearing without at any time stating its position."[20]

[20] (cont'd) "* * * It [motor carrier] also urges that we take official notice of the fact that it is impossible to get government officials to appear in support of motor carrier applications for operating authority.

"We are of the opinion that the evidence is insufficient to justify a grant of the authority sought. No public witnesses appeared in support of the application, and we know of no prohibition against duly authorized representatives of the various departments of the Government appearing in support of an application where the authority sought is required or deemed necessary by the appropriate authority."

[21] Post-Hearing Brief of Intervenors, p. 37.

[7003]

The role of the AEC staff was clearly stated on the record at the commencement of the proceeding, when staff counsel placed in evidence a letter from the AEC General Manager to the members of the staff participating in the proceeding. This letter stated in part (TR 33-37):

> "* * * While section 5(c) of the Administrative Procedure Act requiring separation of functions does not apply to proceedings involving initial licensing, the Commission has felt that adopting the separation

of functions in its first formal hearing under the licensing program is desirable. *In the preparation and conduct of the proceeding, the separated staff will not be subject to supervision by persons not on the separated staff. This staff will not participate in advising the Commission with respect to its decision on the record established at the hearing except by briefs and other statements on the record.* * * *

"*The separated staff will attempt in the public interest to insure that all relevant facts not brought out by the other parties are fully developed at the hearing.* After the Power Reactor Development Company and the intervenors have introduced their respective cases into the record, counsel for the separated staff will introduce such additional evidence as appropriate to insure that an adequate and complete record is presented to the Commission as the basis for its decision. . . . *The separated staff will be free to take such position during the hearing and to make such recommendations and proposed findings to the Commission on the public record as it deems appropriate.*" (Emphasis added.)

The role of the separated staff in helping to develop a complete record for decision was the only proper one which such a staff could take in this proceeding, since the public interest was represented by them at the hearing.[21] The staff was not

[21] *United States v. Merchants & Manufacturers Traffic Association*, 242 U. S. 178, 188 (1916); *County Board of Arlington County v. United States*, 101 F. Supp. 328, 332 (D. C. Va. 1951); *United States ex rel. Chapman v. Federal Power Commission*, 191 F. 2d 796, 800 (4th Cir. 1951).

[7004]

required to take an adversary position with respect to the issues in the proceeding.[92] The proceeding was initial licensing and represented a continuation of the proceeding initiated by issuance of the conditional construction permit, which, under the law and regulations in effect at the time of the permit's issuance, was required to go to hearing upon the filing of the interventions by the Intervenors.[93] The contention

[92] Section 2.730 of our Rules of Practice, 10 C. F. R. § 2.730, provides: "The parties to a formal hearing shall be AEC, the licensee or applicant as the case may be, and any person permitted to intervene. . . ." Section 2.737, 10 C. F. R. § 2.737, provides that "[i]n appropriate cases AEC may file and serve a reply to the answer. . . ." Counsel for the Intervenors appears to have taken an inconsistent position on this point. In a letter to the Commission Chairman, dated December 31, 1956, with respect to the use of Commission consultants as witnesses, counsel stated that "this is not an action against AEC." Post-Hearing Brief, p. 23. With respect to the necessity for the AEC staff to take a position on the record at the commencement of the hearing, the Intervenors claimed that "the Commission is the real defendant in this proceeding," *ibid.* at 37.

[93] Under Section 189a. of the Atomic Energy Act, 42 U. S. C. § 2239(a), "the Commission shall grant a hearing upon the request of any person whose interest may be affected by the proceeding." Section 2.102 of our Rules of Practice, 10 C. F. R. § 2.102, provides:

> "(a) The AEC will, upon request of the applicant or an intervenor, and may upon its own initiative, direct the holding of a formal hearing prior to taking action on the application. If no prior formal hearing has been held and no notice of proposed action has been served as provided in paragraph (b) of this section, AEC will direct the holding of a formal hearing upon receipt of a request therefor from the applicant or an intervenor within 30 days after the issuance of a license or other approval or a notice of denial.

[7005]

that failure to meet the demands of the Intervenors on this question vitiated the entire hearing is without merit.

4. *Access to Restricted Data*

Intervenors contend that they were denied a fair hearing because they did not have access to Restricted Data

when they refused to follow normal security clearance procedures. In support of their contention, they argue that (1) the Restricted Data to which access was sought related only to civilian applications of atomic energy unrelated to the common defense and national security; (2) the requested information has been published, and the Commission is required by statute to declassify the information; (3) it is impossible for the Commission effectively to control Restricted Data in the interest of national security, and consequently there would be no undue risk to the common defense and security in publishing the information or in granting Intervenors' request; and (4) the Commission has violated the First and Fifth Amendments of the Constitution by making Intervenors' access to Restricted Data contingent upon

[94] (cont'd) "(b) In such cases as it deems appropriate, AEC may cause to be served upon the applicant, and published, a notice of proposed action upon his application and shall cause copies thereof to be served upon intervenors or others entitled to or requesting notification. The notice shall state the terms of the proposed action. If a formal hearing has not been held prior to issuance of the notice, AEC will direct the holding of a formal hearing upon the request of the applicant or an intervenor received within fifteen days following the service of the notice."

[7006]

their attorneys' submission to the Commission's security requirements. The Intervenors claim that Restricted Data constituted an essential part of the license application of PRDC, to which access was required by Intervenors' counsel in order to prepare their case, to cross-examine witnesses, and to introduce facts reflected therein in evidence.[94]

All of these contentions were considered and disposed of by the Commission in its Order and Memorandum dated

March 4, 1957, in which we denied Intervenors' motion for access to Restricted Data without compliance with the Atomic Energy Act of 1954 and our regulations issued pursuant thereto.[95] As we pointed out in that order, Restricted Data is a special category of classified information created by our statute. It is not, as Intervenors claim, defense information within the meaning of, or to be handled according to the procedure of, Executive Order No. 10501.[96] Subject to criminal penalties under our statute and regulations,[97] access to Restricted Data is denied to any person until an appropriate investigation and report have been made thereon by the Civil Service Commission, and we have determined that permitting such person to have access to Restricted Data will not endanger the common defense and security.[98]

[95] Post-Hearing Brief of Intervenors, p. 34.
[96] 6 Ad. L. 2d 891 (1957).
[97] 18 Fed. Reg. 7049 (Nov. 10, 1953).
[98] Section 227, 42 U. S. C. § 2277.
[99] Section 145b., 42 U. S. C. § 2165(b).

[7007]

Under "parallel procedures" authorized by statute,[99] our rules provide for making Restricted Data available to any party in the proceeding, his counsel or witnesses who have appropriate security clearances.[100] The fact that Restricted Data has been made available to numerous persons with appropriate security clearance does not mean that we have "published" such information and are therefore required to declassify the Restricted Data involved.

It is no denial of free speech under the First Amendment or due process under the Fifth Amendment, for the Commission to impose reasonable requirements for access to

information which Congress has specifically directed should be protected from disclosure to the general public, provided, as we do, security clearance for access is available on equal terms to all persons.[101]

[99] Section 181, 42 U. S. C. § 2231.
[100] 10 C. F. R. §§ 2.800-2.814.
[101] In support of their claim of violation of the Fifth Amendment, Intervenors cite *Lovell v. City of Griffin*, 303 U. S. 444 (1938) and *Grosjean v. American Press Co.*, 297 U. S. 233 (1936). Both cases are clearly distinguishable. *Lovell* involved a denial of the right to practice one's religion, and a violation of the liberty of the press, inhibited by a vague city ordinance. In *Grosjean* the Supreme Court upheld a decree of the District Court enjoining the enforcement of a state statute, a license tax on advertising in newspapers with large circulations, as violation of the freedom of press. Intervenors' claim that the Fifth Amendment was violated appears to be bottomed on the proposition, with which we agree that due process requires that Intervenors have a reasonable opportunity to know the claims of the other parties. *Morgan v. U. S.*, 304 U. S. 1 (1938). No such denial of opportunity is presented in this proceeding, as was present in the *Morgan* case where the complainant therein was unable to ascertain at any time whatsoever during the course of an administrative proceeding what the claims of the agency, in opposition, were, 304 U. S. 16-19.

[7008]

The prejudice claimed by Intervenors to the presentation of their case in this proceeding arises, if at all, not because of any action on the part of the Commission but solely because they refused to resort to reasonable procedures for security clearance, with due protection of their rights at the hearing while such clearance was being obtained. In effect, the Intervenors refused to exhaust even the most preliminary of the reasonable administrative remedies afforded by the Commission with respect to Restricted Data. Finally, the large majority of the 73 documents sought by Intervenors were declassified in whole or in part by Commission order.

5. Effective Date of Order

Intervenors claim that the Commission "has committed a breach of its regulations by prematurely issuing what

appears to be a final order" attached to its Opinion and Initial Decision dated December 10, 1958. The rule referred to requires that an initial decision contain the "appropriate rule, order, sanction, relief, or denial thereof, with the effective date."[102]

As Intervenors concede, there is nothing in the decision or order which postpones the effectiveness of the order in the event exceptions are filed. The opinion, initial decision, and order are clear that the latter was intended to be immediately effective. Our rules do not, as Intervenors claim, require us to postpone the effective date of the order where, as here, the public interest

[102] 10 C. F. R. § 2.751(c)(4).

[7009]

and that of the Intervenors are protected by the terms of the order. A continuing review on the public record does not prejudice, but protects, those interests, particularly with respect to complete assurance of the safety of the proposed reactor. Making our order immediately effective further accords with our findings, to which Intervenors have not excepted, that (1) the fast breeder reactor is one of the promising types for the development of electric power on a commercially feasible basis, (2) the demonstration of the economic practicability of breeding would increase by many times the available reserves of nuclear fuel today, and (3), by proceeding with construction and further research and development simultaneously, rather than awaiting complete research and development results, Applicant will save several years in the time required to place in operation its power reactor.

[7010]

V. Disposition of Exceptions

Section 2.752 of our Rules of Practice requires that exceptions "shall designate by specific reference the portions of the record relied upon in support of the objections, and shall state the grounds for the exceptions including the citations of authorities in support thereof." In the absence of compliance with these conditions, "any objection to a rule, finding or conclusion . . . shall be deemed to have been waived, and the Commission need not consider such objections." The purpose of the rule, of course, is to afford the Commission an adequate basis on which to review the exceptions of a party and to insure that such review shall fairly include all the material points which the excepting party wishes to make.

The large majority of Intervenors' exceptions do not comply with the above rule. The Intervenors' supporting brief requests the Commission to reexamine all prior briefs and arguments in this proceeding "in connection with their Exceptions to the Opinion and Initial Decision."

Under such circumstances we would be justified in rejecting all of the exceptions which did not comply with our rules.[103] The

[103] *Kings Electronics Co., Inc.*, 4 Ad. L. 2d 557 (N. L. R. B. 1954); *Sucesion Luis Panallo-Castellanos*, 26 F. C. C. 109, 136 (1959); *Fort Worth Investigation* (C. A. B. Dkt. No. 7382, Dec. 16, 1957) (order striking exceptions to initial decision); see *Steelco Stainless Steel, Inc. v. Federal Communications Commission*, 187 F. 2d 693, 697 (7th Cir. 1951).

[7011]

practice of submitting exceptions without record references and citations of authorities cannot be condoned by

the Commission. Because of the important issues in this proceeding, however, we have previously considered in this opinion all of these unsupported exceptions.

The exceptions and objections of the Intervenors are overruled, as follows:

(1) Exceptions 1, 2, 3, 4, 5, 6, 7, 8, 15, 16, 17, 18, 19, 20, 21, 22, 23, 27, 28, 29, 30, and 32, with respect to safety, are overruled for the reasons set forth in Parts I and III-1 and -2 of our decision. Only exceptions 15, 18, 20, 21, 27, 28, 29, and 30 contain citations of authority.

(2) Exceptions 9, 10, 24, 25, 26, and 31, with respect to financial qualification are overruled for the reasons set forth in Parts I and III-3 of our decision. Exception 31 contains no citation of authority.

(3) Exception 11, with respect to the introduction of direct narrative testimony, is overruled for the reasons set forth in Part IV-1. The exception contains no citation of authority.

(4) Exception 12, with respect to claimed intimidation of AEC consultants, is overruled for the reasons set forth in Part IV-2. The exception contains no citation of authority.

(5) Exception 13, with respect to access to Restricted Data, is overruled for the reasons set forth in Part IV-4. The exception contains no citation of authority.

(6) Exceptions 33 and 34, with respect to the legality of the issuance of the provisional construction per-

mit, are overruled for the reasons set forth in Parts I, II, and III of our decision. The exceptions contain no citation of authority.

[7012]

(7) Exception 35, with respect to the AEC staff position, is overruled for the reasons set forth in Part IV-3. The exception contains no citation of authority.

(8) Exception 14 claiming that the operations of PRDC, if conducted under the provisional construction permit, will not be subject to the statute and our regulations, and the unnumbered exception claiming our order of December 10, 1958, to be erroneous, both without any citation of authority, are overruled for the reasons set forth in our entire decision.

(9) The Commission has considered all other points raised by the Intervenors in their briefs, oral argument, exceptions, and on the record and finds them to be without merit.

[7013]

VI. Findings and Conclusions

In addition to the facts found and conclusions of law reached in the course of the opinion, the Commission specifically finds and concludes:

1. Power Reactor Development Company (PRDC) is a duly organized non-profit corporation existing under the laws of the State of Michigan, and its operations will, if conducted according to the construction permit issued by

this Commission dated August 4, 1956, be subject to the Atomic Energy Act of 1954, amendments thereto and the rules and regulations issued by this Commission.

2. PRDC has proposed the construction and, subject to later proceedings, the operation of utilization and production facilities, as defined in Section 104 of the Atomic Energy Act and the rules of this Commission, as a research and development facility consisting of a fast breeder nuclear reactor of 300,000 thermal kilowatts and 100,000 electric kilowatts capacity and having physical features described in the application and the ten amendments thereto which constitute a part of the files and record of the proceeding.

3. PRDC has been issued a construction permit on a provisional basis to construct a fast breeder reactor of the

[7014]

general type set forth in its Application as amended prior to August 4, 1956. Developments in design resulting from improvement in technology require changes in and additions to some of the terms and conditions of the construction permit previously issued. These changes and additions are reflected in the amended construction permit attached hereto and made a part of our order.

4. AEC interest in fast neutron systems goes back several years. Both AEC and the United Kingdom have operated a number of small uncooled critical assemblies and flexible critical experiments. AEC has operated two fast reactors, "Clementine," a 25-thermal kilowatt plutonium-fueled reactor which operated from 1946-1952 and EBR-I,

a 1400 thermal kilowatt (200 electrical kilowatt) uranium-fueled reactor which operated at the National Reactor Testing Station, Idaho, from August 1951-November 1955. The following fast reactors, in addition to Applicant's proposed reactor, are presently programmed:

a. EBR-I is being placed back into operation with two new cores, Mark III and Mark IV. The Commission takes official notice that EBR-I with the Mark III core became operational in November, 1957.

b. EBR-II, a 62,500 thermal kilowatt (20,000 electrical kilowatt), uranium-fueled reactor, will be constructed at the National Reactor Testing Station in Idaho. The Commission takes official notice that funds for construction of EBR-II have been authorized and that construction of EBR-II is currently scheduled to be completed in December, 1959.

[7015]

c. A uranium-fueled reactor with a rated capacity of 60,000 thermal kilowatts was scheduled for completion of construction at Dounreay, Scotland, in December 1958.

5. Technology regarding fast breeder nuclear reactors is a rapidly advancing art, and utilization and production facilities that will permit the most complete use of fuel for atomic energy offer a substantial advancement in this field. The research and development project proposed by PRDC reflects the largest plant in the United States to date which would utilize energy produced by the fast breeder process. Information is increasing as experiments and

corroborative data are supplied regarding the safety in operation of such a plant. Several experiments with existing or proposed fast breeder reactor plants will provide information helpful in the consideration of the operation of the PRDC plant. There is no inherent hazard or danger to the health and safety of the public in the construction or operation of fast breeder reactors.

6. The EBR-II and PRDC reactors are similar in neutron spectrum and flux, power density, fuel element design and coolant operating conditions, but differ in a number of design aspects. Both are based on EBR-I. EBR-II has a more advanced design, and is intended as a flexible experimental facility.

7. The Dounreay and PRDC reactors operate in the same neutron spectrum and have many common characteristics, but also have many differences in detail.

8. Neither EBR-I, EBR-II, nor Dounreay can be considered a direct prototype of the PRDC reactor.

[7016]

9. There is considerable experience in the use of sodium and related materials as coolants, including investigations of sodium technology at Commission laboratories since 1945; operation of EBR-I, the submarine intermediate reactor, and the sodium reactor experiment at Santa Susana, California; and performance tests on mock-ups of the EBR-II sodium system. In general, these sodium systems have operated successfully and have demonstrated the ability to achieve satisfactory purity of sodium and to avoid significant corrosion.

10. Construction of the proposed PRDC reactor on the proposed time schedule represents a greater and more rapid extension of reactor technology beyond demonstrated practice than construction of the other civilian power reactors presently being completed in populated places.

11. The proposed experiments with the EBR-I, Mark III, core are intended to determine definitively whether bowing is the cause of the positive temperature coefficient observed in EBR-I. If properly carried out, they are expected definitively to establish the correctness or incorrectness of the bowing hypothesis.

12. It is highly probable that bowing can be prevented by proper mechanical design. Applicant has proposed three means of preventing inward bowing of the PRDC core.

[7017]

13. The record indicates considerable doubt about the cause of the resonance instabilities observed in EBR-I. They may be attributable to the use of series rather than parallel flow of the coolant through the core and blanket, and the experiments with the Mark III core are designed to test this hypothesis. The PRDC design proposes parallel flow.

14. Apart from certain problems of prompt acting positive temperature coefficients and resonance effects, the answers to which are not yet completely known, fast reactors are generally considered to be as easy to control as thermal reactors. Indeed, it is possible to operate a fast reactor with a relatively small amount of excess reactivity avail-

able, thereby ensuring that an accidental sudden withdrawal of all controls will not result in a dangerous nuclear runaway. PRDC proposes, at least during the early years of operation, to adhere to such a limitation of excess reactivity.

15. Although many questions remain to be answered regarding the problem of meltdown and disassembly or reassembly of the core or a substantial portion thereof, there is reasonable assurance that these questions will be answered in due course and in time for the answers to precede any decision of the Commission with regard to an operating license for the proposed PRDC reactor; and design modifications of the reactor may be available as a means of avoiding these problems.

[7018]

16. In view of the relative lack of operating experience with fast power reactors, additional satisfactory operating experience with such reactors prior to the commencement of operation of Applicant's proposed reactor will be highly desirable. Present schedules indicate that considerable operating experience with EBR-I and Dounreay, and possibly some with EBR-II, will have been obtained prior to the start of PRDC test operations.

17. It is possible that there may be presently unknown effects in large fast reactor systems. A prototype of the proposed reactor at a remote location has been urged as affording greater assurance against the possibility of such unknown effects than does the presently planned experimental and theoretical programs. The Commission finds that the necessity, however, for constructing such a proto-

type has not been shown. If the program of meltdown investigation should prove inconclusive, it will be necessary to reconsider the question of need for a prototype.

18. Based on the foregoing findings, and of this record, the Commission further finds that—

a. It has not been positively established that a fast breeder reactor of the general type and power level proposed by Applicant can be *operated* without a credible possibility of releasing significant quantities of fission products to the environment;

b. There is reasonable assurance that theoretical and experimental investigations which have been undertaken, together with operating

[7019]

experience on one or more of the EBR-I, EBR-II and Dounreay reactors, will establish definitively, prior to the scheduled completion date of the PRDC reactor, whether or not the reactor proposed by Applicant can be so operated;

c. There is reasonable assurance that evidence will establish that the reactor proposed by Applicant can be so operated.

19. The proposed site is located on the shore of Lake Erie about thirty miles from Detroit, Michigan, twenty-five miles from Toledo, Ohio, seven and one-half miles from Monroe, Michigan, and ten miles from the Canadian border. The site is bordered on one side by water and provides an exclusion area on the land side with a minimum radius of

2900 feet. The population distribution for given distances from the site is as follows:

Miles	*Population*
1	175
2	600
5	1,800
10	31,300
20	187,100
30	2,001,700

During the summer months the population within five miles would be increased due to vacationing transients and to the fact that beaches two to five miles southwest of the site may be crowded with thousands of people.

20. There is reasonable assurance that the site is satisfactory from structural and underground water flow stand-

[7020]

points. The meterology of the site is complex, but no reason appears in the record for it to be disqualifying. Studies of the meterology, lake currents, air diffusion, flooding and similar problems will be completed before the question of a license to operate is before the Commission Design modifications required by the results of those studies will be considered at that time.

21. A definitive evaluation of the suitability of the proposed reactor depends upon the inherent safety of the reactor and a demonstration that no credible accident can release significant quantities of fission products into the atmosphere. If the foregoing are established, and there

is reasonable assurance that they can be, the site will prove suitable for the proposed reactor.

22. The Commission finds reasonable assurance in the record, for the purposes of this provisional construction permit, that a utilization facility of the general type proposed in the PRDC Application and amendments thereto can be constructed and operated at the location without undue risk to the health and safety of the public.

23. Applicant's current estimate for the cost of construction, pre-construction research and development, and administrative expenses during construction and test operation is $44,020,000. It has assets, consisting of firm commitments for contributions from members and an executed bank loan agreement, totalling $49,448,000 and thus exceeding its estimated costs by

[7021]

$5,428,000. There is reasonable assurance that the member companies of PRDC could provide additional funds, if necessary, to take care of adverse contingencies. Applicant's utility members have combined equity assets of $2 billion.

24. There is a likelihood of a cost over-run on construction and research and development, and increases have already occurred on specific items. The record, however, does not demonstrate that such an over-run will exceed Applicant's available assets by any amount and especially by an amount large enough to disprove PRDC's financial qualification.

25. Provision is made in Applicant's cost estimates for payment of Commission charges for use and burn-up of source and depleted material. The amount of possible Commission charge for loss of depleted and special nuclear material has not been identified and will depend on determination of the magnitude and consequences of the maximum credible accident. Applicant believes that in any accident a substantial part of the material would be reclaimable and that its exposure to a charge for loss is on the order of $1 million. It expects to cover its potential liability for loss by either insurance, application of its unencumbered assets, or a guarantee from its sponsors. The Commission finds that Applicant has shown reasonable assurance of being able to pay Commission charges for loss of special nuclear material through 1963.

26. The fast breeder reactor is one of the promising types for the development of electric power on a commercially feasible basis. Demonstration of the economic practicability of breeding

[7022]

would increase by many times the available reserves of nuclear fuel by facilitating the conversion into plutonium and use as fuel the Uranium-238 isotope which comprises 99.3% of the natural uranium.

27. By proceeding with construction and further research and development simultaneously, rather than awaiting complete research and development results, Applicant will save several years in the time required to place in operation its demonstration power reactor.

28. The proposed reactor will be a utilization facility within the meaning of 10 C. F. R. § 50.2(h) and will be involved in the conduct of research and development activities leading to the demonstration of the practical value of such facilities for industrial and commercial purposes.

29. Applicant and the organizations with which it is associated by contract are technically qualified to design and construct the reactor described in the Application.

30. For the purposes of a provisional construction permit, there is reasonable assurance that a reactor of the general type described in the Application can be so designed that no credible accident in the course of its operation is likely to result in the release of significant quantities of fission products into the atmosphere.

31. There is reasonable assurance that theoretical and experimental programs under way will develop sufficient data to justify the issuance of an operating license, and that the

[7023]

results of these programs will be available prior to the time it is necessary for the Commission to rule on the operating aspect of the PRDC license Application.

32. There is reasonable assurance that the proposed site is generally suitable for a reactor of the type and size described in the Application. If the reactor is otherwise shown to be capable of operation without undue risk to the public health and safety, including demonstrations of stability and adequate containment. Adequate investi-

gations are under way to establish the characteristics of the proposed site, including all relevant aspects with respect thereto.

33. There is reasonable assurance that technical information omitted from the Application and required to complete the Application will be supplied prior to the time when it is necessary for the Commission to rule on the operating aspect of the license Application.

34. For the purposes of a provisional construction permit, there is reasonable assurance that the Applicant is financially qualified to engage in the construction and operation of the reactor described in the Application and to receive the allocation of special nuclear material therefor.

35. The issuance of a provisional construction permit to the Applicant will not be inimical to the common defense and security or to the health and safety of the public.

36. The public interest required the establishment of procedures for continuing review of the PRDC project, as provided in our Order dated December 10, 1958, amended this date, so as to require both PRDC and the separated staff of the AEC, and to permit the

[7024]

Intervenors in this proceeding, to submit to all participants in the proceeding, as well as file with the Secretary of the Commission, where they will be publicly available, data coming to the attention of any one of them pertinent to safety in construction, design and operating

characteristics of fast breeder nuclear reactors similar or identical to the PRDC project, thus to enable the Commission to consider such data and to provide for a further hearing in this instant matter, if deemed advisable prior to the final license proceeding. It is not anticipated that a hearing would be advisable or necessary upon the filing of each portion of data, but when any single filing itself or the accumulation of data filed warrants, the Commission intends on either its own motion or the motion of one of the participants to set a hearing to provide for further review of safety considerations.

37. Proceedings for a license to *operate* the proposed PRDC plant shall be held at a time later to be determined, after the completion of construction. In that proceeding the safety and financial considerations of the PRDC project will be in issue, and we shall again consider whether the PRDC plant can be *operated* with reasonable assurance for the protection of the health and safety of the public.

Chairman John A. McCone and Commissioner Willard F. Libby did not participate in the consideration or decision in this case.

HAROLD S. VANCE,
Commissioner.

JOHN F. FLOBERG,
Commissioner.

JOHN S. GRAHAM,
Commissioner.

[7025]

UNITED STATES OF AMERICA
ATOMIC ENERGY COMMISSION

In the Matter
of
POWER REACTOR DEVELOPMENT COMPANY.

Docket No. F-16.

ORDER

On the basis of the Opinion and Final Decision adopted this date in the above-entitled cause, the Commission hereby orders that:

A. The construction permit heretofore issued to Power Reactor Development Company on August 4, 1956, is hereby affirmed and continued in effect with such modifications and additions as are shown in the permit hereto attached and made a part of this Order.

B. The amendments to its Application filed by PRDC after the issuance of the provisional construction permit on August 4, 1956, are added to and incorporated in the record.

C. By Order of the Commission dated December 10, 1958, procedure was established for continuing review of the safety characteristics of the PRDC fast breeder nuclear reactor plant. Pursuant to said Order and the construc-

tion permit as amended December 10, 1958, and this date, PRDC and the separated staff of this Commission are directed, and any Intervenor herein is permitted, to serve upon all participants herein and to file with the Secretary of this Commission, who will make them publicly

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available to anyone concerned, data pertinent to the safety in construction, design, and operating characteristics of fast breeder nuclear reactors similar or identical to PRDC project so as to permit review by the Commission, which may set down for hearing, when deemed advisable, the further consideration of such data.

D. This order shall be made immediately effective.

WOODFORD B. McCOOL
Secretary

DATED: May 26, 1959

SEAL

[7027]

UNITED STATES OF AMERICA
ATOMIC ENERGY COMMISSION

In the Matter
of
POWER REACTOR DEVELOPMENT COMPANY.

Docket No. F-16.

CONSTRUCTION PERMIT AS AMENDED

The Construction Permit heretofore issued in this proceeding, as amended December 10, 1958, is further amended this date to read as follows:

Pursuant to the Atomic Energy Act of 1954, as amended, and Title 10, C. F. R. Chapter 1, Part 50, "Licensing of Production and Utilization Facilities", the Commission hereby issues a provisional construction permit to Power Reactor Development Company; a Michigan corporation (hereinafter PRDC), to construct the facility described herein as a utilization facility in accordance with the Application and amendments thereto filed in this docket. This permit shall be deemed to contain and be subject to the conditions specified in Sections 50.54 and 50.55 of said regulations; is subject to all applicable provisions of the Atomic Energy Act of 1954, as amended, and rules, regulations and orders of the Atomic Energy Commission now or hereafter in effect; and is subject to any additional conditions specified or incorporated below:

A. The earliest date for completion of the facility is December 15, 1959. The latest date for completion of the facility is December 15, 1960. The term "completion date" as used herein means the date on which the construction of the reactor is completed except for the introduction of the fuel material.

B. The site proposed for the facility is the location known as Lagoona Beach, Monroe County, Michigan, described in the Application.

C. The general type of facility authorized for construction is an enriched uranium-fueled, sodium cooled fast neutron breeder reactor designed to produce approximately 100,000 kilowatts of electrical energy, with associated structures, as described in the Application, and the amendments filed thereto.

D. The Applicant may proceed to design and construct the proposed facility without further authorization in accordance with the Application and the amendments thereto filed in this proceeding and heretofore made a part of the record herein. This permit, however, does not constitute final approval of any technical specification of the facility. Before a license is issued to operate the facility, the Commission must finally approve all technical specifications. If the Applicant desires any final approval of any particular specification prior to the issuance of a license to operate, it may request that the Commission grant specific approval of any specification by appropriate amendment to this permit.

[7029]

E. In accordance with the time schedule established in Paragraph E of the construction permit as amended on December 10, 1958, namely, within three (3) months from December 10, 1958, and at three-month intervals thereafter, or less if in its judgment significant changes or developments have occurred, Applicant shall continue to submit, under oath or affirmation, reports showing—

1. The status of technical investigations being conducted by or for PRDC on the following subjects, and any results obtained therefrom:

a. stability of fast reactors, including autocatalytic and resonance effects;

b. revised temperature and power coefficients of the proposed PRDC reactor;

c. validity of oscillator technique to determine either of the foregoing;

d. possibility and consequences of meltdown of a core of a fast reactor;

e. adequacy of containment proposed for PRDC reactor, including missile effects;

f. meteorology, hydrology, lake current and flooding studies, and other significant environmental information concerning the proposed site;

g. analysis of maximum credible accident.

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2. Decisions made by Applicant as to any design changes referred to in the written testimony in this proceeding, and any other design changes of the facility significantly affecting public safety;

3. Status of construction of the project, scheduled dates of design freezes on major plant components, and any changes in scheduled completion date.

F. In accordance with the time schedule established in Paragraph F of the construction permit as amended on December 10, 1958, namely, within six (6) months from December 10, 1958, and at six-month intervals thereafter, Applicant shall continue to submit reports, under oath or affirmation, showing financial statements of PRDC and APDA, current cost estimates for construction and research and development in connection with the project, and a current statement of source and allocation of cash during a ten-year operating period.

This permit is provisional to the extent that a license authorizing operation of the facility will not be issued by the Commission unless PRDC has submitted to the Commission (by proposed amendment to the Application) the complete, final Hazards Summary Report (portions of which may be submitted and evaluated from time to time), and the Commission has found that the final design provides reasonable assurance that the health and safety of the public will not be endangered by operation of the facility in accordance with the specified procedures.

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It is further provisional to the extent that the Commission reserves jurisdiction, at any time prior to issuance of an operating license, upon notice to the parties herein, to reopen this proceeding for the purpose of receiving additional evidence, and to make such determinations and take such action with respect to the continuance, vacation, or modification of this permit as the entire record warrants.

Upon completion (as defined in Paragraph A above) of the construction of the facility in accordance with the terms and conditions of this permit, as amended, upon the filing of any additional information needed to bring the original Application up to date, upon filing of proof of financial protection and execution of an indemnity agreement as required by Section 170 of the Act and 10 C. F. R. Part 140, upon a finding that the facility authorized has been constructed in conformity with the Application as amended and in conformity with the provisions of the Act and the rules and regulations of the Commission, and upon a further finding, after conclusion of additional proceedings, if they be necessary or appropriate, of reasonable assurance of safety of operation, the Commission will consider the issuance of a license to PRDC pursuant to Section 104b. of the Act, which license will, if issued, expire August 4, 1981.

Pursuant to Section 50.50 of the regulations in 10 C. F. R., Chapter 1, Part 50, the Commission has allocated to PRDC for use in connection with the reactor, 3,117.35 kilograms of Uranium-235

[7032]

contained in uranium at the isotopic ratios specified in PRDC's Application for the license. Estimate schedules of special nuclear material transfers to PRDC and returns to the Commission are contained in Appendix "A" which is attached hereto. Shipments by the Commission to PRDC in accordance with column 2 of Appendix "A" will be conditioned upon PRDC's return to the Commission of material substantially in accordance with column 3 of Appendix "A".

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APPENDIX "A"

TO

POWER REACTOR DEVELOPMENT COMPANY

CONSTRUCTION PERMIT

ESTIMATE SCHEDULE OF TRANSFERS OF SPECIAL NUCLEAR MATERIAL FROM THE COMMISSION TO PRDC AND TO THE COMMISSION FROM PRDC:

(1) Date of Transfer (Calendar Year)	(2) Transfers from AEC to PRDC Kgs. U-235	Returns by PRDC to AEC Kilograms U-235 Recoverable Scrap	Spent Fuel	Net Yearly Distribution Kgs. U-235	Cumulative Distribution Kgs. U-235
1958	673.19	134.57	—	538.62	538.62
1959	—	—	—	—	—
1960	436.43	87.21	—	349.22	887.84
1961	969.03	193.64	572.29	203.10	1,090.94
1962	887.65	177.39	795.45	(85.19)	1,005.75
1963	1,346.30	269.06	765.88	311.36	1,317.11
1964	1,109.59	221.75	915.95	(28.11)	1,289.00
1965	1,050.41	209.93	758.61	81.87	1,370.87
1966	1,257.53	251.32	780.88	225.33	1,596.20
1967	909.85	181.82	735.77	(7.74)	1,588.46
1968	1,109.59	221.75	778.03	109.81	1,698.27
1969	1,331.48	266.09	839.06	226.39	1,924.66
1970	1,139.18	227.66	838.43	73.09	1,997.75
1971	1,109.59	221.75	776.47	111.37	2,109.12
1972	1,272.32	254.26	776.90	241.16	2,350.28
1973	1,198.34	239.49	890.32	68.53	2,418.81
1974	1,257.53	251.32	781.39	224.82	2,643.63
1975	1,124.36	224.69	735.45	164.22	2,807.85
1976	1,198.34	239.49	839.01	119.84	2,927.69
1977	1,168 78	233.58	776.55	158.65	3,086.34
1978	1,139.18	227.66	955.33	(43.81)	3,042.53
1979	1,257.53	251.32	931.39	74.82	3,117.35
1980	909.85	181.82	735.64	(7.61)	3,109.74
1981	—	—	471.09	(471.09)	2,638.65
	23,856.05	4,767.57	16,449.83	2,638.65	

VOLUME III

TRANSCRIPT OF RECORD

Supreme Court of the United States

OCTOBER TERM, 1960

No. 315

POWER REACTOR DEVELOPMENT COMPANY, PETITIONER,

vs.

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL-CIO, ET AL.

No. 454

UNITED STATES, ET AL., PETITIONERS,

vs.

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL-CIO, ET AL.

ON WRITS OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

NO. 315 PETITION FOR CERTIORARI FILED AUGUST 12, 1960

NO. 454 PETITION FOR CERTIORARI FILED SEPTEMBER 29, 1960

CERTIORARI GRANTED NOVEMBER 14, 1960

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[fol. 3920] In evidence January 8, 1957, Tr. 42

BEFORE THE ATOMIC ENERGY COMMISSION

Docket No. F-16

In the Matter of

POWER REACTOR DEVELOPMENT COMPANY

TESTIMONY OF ERNEST R. ACKER, VICE-PRESIDENT, POWER REACTOR DEVELOPMENT COMPANY

Background and Qualifications

My name is Ernest R. Acker. I am a member of the Board of Trustees of Power Reactor Development Company (PRDC). I am also a Vice-President of PRDC, a member of the Executive Committee and Chairman of the Financial Committee. I am President of Central Hudson Gas & Electric Corporation, which is a member of PRDC.

I graduated from Cornell University with a degree in mechanical engineering in 1917. During World War I, I served in the Chemical Warfare Service with the rank of First Lieutenant. In 1919 I commenced my employment with Central Hudson Gas & Electric Company, predecessor of the present corporation, and I have been with this organization continually since that date. I began my employment in the Engineering Department and subsequently became General Superintendent of the Kingston District of the Company and later General Commercial Manager of the Company. I have been a Director of Central Hudson Gas & Electric Corporation since 1927 and have held the [fol. 3921] position of President and General Manager of that corporation since 1932. I am a member of Tau Beta Pi, an honorary engineering society. I have been President of Edison Electric Institute and the American Gas Association. I am also a member of the Board of Directors of Atomic Power Development Associates, Inc. (APDA), and have been since its organization.

Organization and Background of Power Reactor Development Company

PRDC is a Michigan non-profit membership corporation organized to study and demonstrate the economic and technical feasibility of producing electricity from nuclear fuels through the design, construction and operation of a developmental nuclear power reactor. PRDC is now engaged in the design, development and construction of a full scale fast neutron breeder reactor at a site on Lake Erie in Monroe County, Michigan. This reactor will provide steam which will be used for the production of electricity in facilities owned by The Detroit Edison Company. The entire plant will be known as the Enrico Fermi Atomic Power Plant. Copies of the Articles of Incorporation and By-Laws of PRDC are included as Exhibit III and Amended Exhibit IV to the Application, as amended, for a license under Section 104 b of the Atomic Energy Act of 1954, filed by PRDC. PRDC is a membership corporation and as such cannot issue shares of stock or any other evidence of ownership. The members of PRDC are twenty-one in number and are all corporations.

[fol. 3922] There are thirteen operating utility company members as follows:

Central Hudson Gas & Electric Corporation
Cincinnati Gas & Electric Company
The Columbus and Southern Ohio Electric Company
Consumers Power Company
Delaware Power & Light Company
The Detroit Edison Company
Iowa-Illinois Gas & Electric Company
Long Island Lighting Company
Philadelphia Electric Company
Potomac Electric Power Company
Rochester Gas & Electric Corporation
The Toledo Edison Company
Wisconsin Electric Power Company

There are seven industrial company members as follows:

Allis-Chalmers Manufacturing Company
The Babcock & Wilcox Company

Burroughs Corporation
Combustion Engineering, Incorporated
Fruehauf Trailer Company
Holley Carburetor Company
Westinghouse Electric Corporation

Another member is a service company, Southern Services, Inc. representing Alabama Power Company, Georgia Power Company, Gulf Power Company, Mississippi Power Company, each of which is an operating utility and a contributor to PRDC, and the parent of those five companies, The Southern Company. Southern Services, Inc., also provides the Trustee representative.

The purpose of PRDC is to do research and development in the field of the peacetime application of atomic energy for the production of electric power through the construction and operation of a developmental power reactor, and to make information acquired from these research and de- [fol. 3923] velopment activities available, not only to its members but also to the Atomic Energy Commission (AEC) for the use of the public, and to all others who may desire such information, subject solely to AEC security regulations. PRDC is not organized for profit. The Articles of Incorporation provide that no part of the net earnings of PRDC may inure to the benefit of any member, any private individual, or any corporation. They provide further that members may receive nothing on dissolution, since in the case of dissolution any remaining assets must be turned over to an organization or organizations operated exclusively for educational or scientific purposes. Under the By-Laws of PRDC members are prohibited from obtaining any special privilege to use patents which may be developed by PRDC, and the By-Laws also require that all such patents be made freely available to anyone who may properly request their use.

Memberships in PRDC are non-transferable, and changes can occur only when new members are elected or old members resign, and members may be elected to membership and resign membership. There is no written instrument evidencing membership. Each member has one vote regard-

less of the amount of its financial contribution to the activities of PRDC.

The affairs of PRDC are conducted by a Board of Trustees, twenty-seven in number, who are elected by the members. No member may be represented on the Board of Trustees by more than one person. The Trustees are as follows:

[fol. 3924] Ernest R. Acker, President
Central Hudson Gas & Electric Corporation
Dr. Robert F. Bacher, Director
Norman Bridge Laboratory
California Institute of Technology
Walter C. Beckjord, President
The Cincinnati Gas & Electric Company
George Bisset, Vice-President
Potomac Electric Power Company
Walker L. Cisler, President
The Detroit Edison Company
John S. Coleman, President
Burroughs Corporation
Stuart Cooper, Chairman
Delaware Power & Light Company
Errol W. Doebler, President
Long Island Lighting Company
George D. Ellis, Vice-President
Combustion Engineering, Incorporated
Robert E. Ginna, President
Rochester Gas & Electric Corporation
Dr. Lawrence R. Hafstad, Vice-President in Charge of Research
General Motors Corporation
Daniel C. Hickson, Vice-President
Bankers Trust Company
George M. Holley, Jr., President
Holley Carburetor Company
Alfred Iddles, President
The Babcock & Wilcox Company
Charles E. Ide, President
The Toledo Edison Company

[fol. 3925] Dan E. Karn, President
Consumers Power Company
Edward L. Love
Chase Manhattan Bank
Jackson Martindell, President
American Institute of Management
Harry M. Miller, President
Columbus & Southern Ohio Electric Company
Alexander C. Monteith, Vice-President
Westinghouse Electric Corporation
R. George Rincliffe, President
Philadelphia Electric Company
J. Frank Roberts, Vice-President
Allis-Chalmers Manufacturing Company
Herbert J. Scholz, President
Southern Services, Inc.
Dean E. Blythe Stason
Law School, University of Michigan
Gould W. VanDerzee, President
Wisconsin Electric Power Company
Charles H. Whitmore, President
Iowa-Illinois Gas & Electric Company
Dr. Theodore P. Wright, Vice-President
for Research
Cornell University

It will be observed that each member company, except Fruehauf Trailer Company, is represented by a trustee. Each trustee is an officer of the company he represents, and in addition there are trustees who are unconnected with any member and who represent the fields of education, finance and scientific research.

[fol. 3926] The Board of Trustees elects the principal officers of the company. They are as follows:

Walker L. Cisler, President
(The Detroit Edison Company)

R. George Rincliffe, Executive Vice President
(Philadelphia Electric Company)

Dan E. Karn, Vice President
(Consumers Power Company)

Herbert J. Scholz, Vice President
(Southern Services, Inc.)

Ernest R. Acker, Vice President
(Central Hudson Gas & Electric Corporation)

John A. Lagrou, Treasurer and Assistant Secretary

John F. Anderson, Assistant Treasurer and
Assistant Secretary

George E. Olmsted, Secretary and Assistant
Treasurer

Errol Doebler
(Long Island Power & Lighting)

The Board of Trustees also functions through the following committees whose respective responsibilities are apparent from their names: The Executive Committee (of which I am a member), The Technical and Engineering Committee, The Administrative Advisory Committee, The Legal Committee, The Financial Committee (of which I am Chairman), and The By-Laws Committee. While one or more trustees serve on each committee, the committees also include others who are not trustees.

The utility company members and contributors provide approximately 17% of the electric generating capacity of [fol. 3927] the investor-owned utility companies in the United States, have a combined earned surplus of approximately $400,000,000, and have combined assets in excess of $2,000,000,000. In addition, the industrial members have very substantial financial resources and are important representatives of various segments of American industry. It is the purpose of the members of PRDC to construct and operate the reactor portion of the Enrico Fermi Atomic Power Plant in order to provide themselves and the country with the knowledge that will be gained in this important area of the utilization of nuclear materials.

The origin of the PRDC fast breeder reactor goes back to April, 1951, when The Detroit Edison Company and Dow Chemical Company entered into a study agreement with the AEC to conduct research, looking to the feasibility of generating electricity by the use of fissionable materials.

In the period between 1952 and 1955 certain other companies joined the study group initiated by The Detroit Edison Company and Dow Chemical Company. In 1954 Dow Chemical Company withdrew from the group to concentrate on the application of atomic energy to chemical processes. APDA was organized as a New York membership corporation in March of 1955 to carry on the work which had previously been conducted by this study group. As a result of its studies, APDA determined that the fast neutron breeder reactor held great promise because of conservation of nuclear fuels possible through the use of this type of reactor. As Dr. Bethe has stated in his testimony, the [fol. 3928] development of breeder reactors is of the utmost importance to an economic use of nuclear fuels for peacetime purposes because of the fuel conservation possible.

The adoption by Congress of the Atomic Energy Act of 1954 to encourage participation of private industry in advancing the peacetime application of the atom made possible an extended industrial effort in this area. In January, 1955, the AEC announced its Power Demonstration Reactor Program and invited industry to submit proposals for the construction of reactors of various types. On March 30, 1955, The Detroit Edison Company, on behalf of a group of companies, all of which are now members of PRDC, submitted to the AEC a proposal under this program to design, construct, own and operate a developmental fast neutron breeder reactor. On August 8, 1955, the AEC announced that the March 30 proposal was acceptable as a basis for further negotiation. Copies of the proposal made by The Detroit Edison Company to the AEC and of the acceptance of the proposal as a basis for negotiation are contained in the PRDC Application for License as Exhibits I and II, respectively. PRDC and the AEC are now negotiating an operating agreement under the Power Demonstration Reactor Program.

I think I should make clear the fact that Atomic Power Development Associates, Inc. (APDA) and Power Reactor Development Company (PRDC) are completely separate and distinct companies. I have already described PRDC [fol. 3929] in some detail. APDA is primarily a technical and design research organization in the field of fast breeder

reactors, and is responsible for the conceptual design of the PRDC reactor. Many of the twenty-one member companies of PRDC are also members of APDA, although not all of them are, and APDA has many members which are not members of PRDC.

APDA, working with PRDC on the fast breeder developmental reactor, is performing design, technical and research functions. APDA will also conduct non-nuclear tests of certain reactor components, and upon the conclusion of such tests will transfer certain of the tested equipment and devices to PRDC for incorporation in its reactor. Arrangements between PRDC and APDA have been formalized in a contract dated December 14, 19[illegible], included as Exhibit XXI to the PRDC Application for License and incorporated in this testimony by reference.

The management of PRDC has been guided and will continue to be guided by the design, technical and safety recommendations received from APDA from time to time. PRDC will also conduct the pre-operational and other tests recommended by APDA, in consultation with PRDC consultants, and will adopt start-up, operational and other procedures in accordance with such recommendations. Much of the testimony to be given in this proceeding with respect to the research and test program for the Enrico Fermi reactor is accordingly presented by two APDA employees who are particularly familiar with this area of APDA work, Mr. A. Amorosi and Mr. W. J. McCarthy.

[fol. 3930] On January 7, 1956, PRDC filed an Application for License under Section 104 b of the Atomic Energy Act of 1954 to construct and operate a fast neutron breeder reactor. This Application has been amended from time to time and is now pending. On August 4, 1956, the AEC granted PRDC a provisional construction permit.

PRDC Safety Policy

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Public safety, therefore, has been and is of prime concern to the PRDC management. We are completely satisfied that there is no public risk, whatever involved in going forward with the plant construction work at this time. In addition, we will certainly not place the plant in operation [fol. 3931] unless the safety experiments to be conducted

satisfy both the AEC and the staff and consultants of PRDC and APDA that the reactor can be operated without endangering the public health and safety.

Furthermore, the management of PRDC believes that any financial risk in proceeding with the immediate construction of the reactor—and no other risk is involved—is fully justified by the time savings involved. By proceeding with both the construction and the research and experimental program at the same time, we should be able to save several years in the time required to place in operation a demonstration power reactor of significant size which we believe will point the way to the economically feasible production of electric power through the use of nuclear materials. We believe that this time saving is important to the advancement of the technology of nuclear power production, as well as to the preservation of American leadership in the peaceful application of atomic energy.

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[fol. 3947]

Management Responsibilities. As has been noted heretofore, the management of PRDC did not authorize the filing of the Application for License with the AEC until it was assured by its staff and consulting technicians, engineers and physicists that the health and safety of the public could not possibly be endangered by the construction of the fast breeder reactor at its proposed site in Monroe County, Michigan, and that any problems requiring solution with respect to the operation of the reactor could be satisfactorily resolved. The management of PRDC is, of course, aware that further important research and experiments are to be conducted during the construction period, and in fact has arranged for the conduct of a substantial amount of such research and experimental work, in order to provide further experimental evidence that its reactor can, when constructed, be operated safely. We consider that the most [fol. 3948] important contribution we can make in expediting the development of the use of atomic energy for the production of electricity is to proceed with the construction of the proposed fast breeder reactor in reliance upon the advice of our staff and consultants. Before the plant is placed in operation all essential safety experiments will have been conducted. We will not place the plant in opera-

tion unless these experiments satisfy both the AEC and the staffs and consultants of PRDC and APDA that the reactor can be operated without endangering the health and safety of the public. We are confident that this will be the case and that it is in the best interest of the public for the construction of this project to go forward without unnecessary delay.

[fol. 3950] In evidence January 8, 1957, Tr. 43

BEFORE THE ATOMIC ENERGY COMMISSION

Docket No. F-16

In The Matter Of

POWER REACTOR DEVELOPMENT COMPANY

TESTIMONY OF HANS A. BETHE, PROFESSOR OF PHYSICS, CORNELL UNIVERSITY

(1) *Biography and Qualifications*

My name is Hans A. Bethe. I am John Wendell Anderson Professor of Physics at Cornell University. I was born in Strassburg, Alsace-Lorraine, on July 2, 1906. I studied at the Universities of Frankfort and Munich and obtained the degree of Doctor of Philosophy in Physics from the University of Munich in 1928. From 1928 through 1933 I taught theoretical physics at the Universities of Frankfort, Stuttgart, Munich and Tubingen. From 1933 through 1935 I was lecturer at the Universities of Manchester and Bristol in England. I came to Cornell University as an assistant professor in 1935 and have been a full professor since 1937.

My general field is theoretical physics. My work from 1934 to 1940, and again since 1946, has been chiefly in nuclear physics. In 1934 intensive study of this subject was just beginning. Many experimental data were constantly obtained, and one of my main activities was to correlate these data, to interpret them and to obtain from them a theoretical understanding of the structure of atomic nuclei

and of the reactions between them. In 1936 and 1937 I wrote three comprehensive review articles, together of the length of an average book, on nuclear physics. These articles were frequently reprinted and served for about 15 years as the standard textbook from which students as well as active research workers in the field obtained their information, in this country as well as abroad.

[fol. 3951] A large fraction of my research work before the War was spent on investigating the properties of neutrons. While not doing any experiments myself, I kept in close contact with the experimental work on neutrons at Cornell University. Our University was a pioneer in this field; in particular we developed the first accurate neutron velocity selector to study the resonances in the interaction of slow neutrons with nuclei.

I also worked on the energy generation in stars by means of nuclear reactions. My theory of this process, first developed in 1938, is generally regarded as the explanation of the large energy production in the sun and other stars. For this work I received two A. Cressy Morrison prizes from the New York Academy of Sciences and the Henry Draper Medal from the National Academy of Sciences.

I am a member, among others, of the National Academy of Sciences, the American Philosophical Society and the American Physical Society. I was President of the latter society in 1954. I hold four honorary degrees of Doctor of Science, from Brooklyn Polytechnic Institute and from the Universities of Denver, Chicago, and Birmingham, England.

Early in the War I became engaged in war research. My first war work, in 1940, was concerned with the penetration of armor by projectiles. This work has been extended by other scientists and the results have been widely used by Ordnance experts, and as far as I know still form the basis of understanding of armor penetration.

Next I was asked to work for Division 8 of the National Defense Research Council which was concerned with shock waves produced by explosives, especially in air and water. During 1941 and 1942, I wrote three papers on the subject of shock waves.

[fol. 3952] Early in 1942 I started work for the Radiation Laboratory at MIT which was concerned with the development of Radar.

In the summer of 1942 I was asked to join a small group of theoretical physicists in Berkeley, California, under the direction of J. R. Oppenheimer which was set up by the "Metallurgical Project" at Chicago. The purpose of the Metallurgical Project was to obtain a chain reaction in uranium and then to use this chain reaction for the manufacture of plutonium. The task of our theoretical group was to study methods by which nuclear explosions could be obtained from fissionable material. This group was the core of the later Los Alamos Scientific Laboratory which was started in April 1943.

I was a member of the Los Alamos Scientific Laboratory from its beginning. When a definite organization of the Laboratory was adopted, I was appointed Chief of the Theoretical Division of the Laboratory and remained in that position until December 1945, after the end of the War. Our Division was responsible for all calculations concerning the atomic bomb, and for most of its conceptual design. In particular we had to devise methods to calculate the diffusion of neutrons in fissionable material and in reflectors, methods which have later proved useful for the study of reactors. We had to calculate the course of a nuclear explosion before any one was ever observed. I am, therefore, thoroughly familiar with calculations of nuclear explosions and with the conditions that are required for such explosions. We also studied ordinary, nonnuclear explosions and the behavior of materials when hit by the shock from ordinary explosions. While all this work was carried out by a large group of people in my division, at one time more than 80 individuals, I kept in close contact with all phases of the work and contributed myself to the solution of many of these problems.

For my work at Los Alamos, I received the Medal of Merit, the highest decoration that can be awarded to a civilian by the United States Government.

[fol. 3953] After the War, I returned to Cornell University. However, I kept in close contact with the development of atomic energy both for war and for peaceful purposes.

In the first place, I became a consultant to the Los Alamos Scientific Laboratory. This involved further work on nuclear weapons, but in addition it served to keep me informed on new methods to estimate nuclear explosions, and on new calculational methods for neutron diffusion. I also kept informed on the newest measurements of nuclear cross sections and participated in the interpretation of some of these which are particularly important for fast breeder reactors.

In addition, I became a consultant to several Laboratories concerned with the design of atomic reactors. I worked particularly intensively with the Knolls Atomic Power Laboratory (KAPL) at Schenectady, from its founding in 1946 until approximately 1950. After this time, KAPL became involved in very special problems relating to Naval Reactors, and although I continued as a consultant I spent much less time on this work. From 1946 to 1950, when I did participate actively, the major project of KAPL was the design of a breeder reactor, which was first intended to work with neutrons of intermediate energy and later with fast neutrons. In this connection, I stimulated and closely followed a program to determine experimentally a certain quantity, the ratio of capture to fission in U^{235} and Pu, which is decisive for the breeding qualities of the breeder reactor. Many novel experimental techniques were invented by the Knolls Atomic Power Laboratory in connection with their fast breeder work. About 1949, I wrote a report for KAPL on the safety of their proposed reactor, in particular on the mild nuclear explosion which could occur as a result of a possible nuclear accident. This report is, to my knowledge, the first report on the theory of nuclear accidents of power reactors.

[fol. 3954] I also consulted for NEPA, a project for nuclear propulsion of aircraft, from 1946 to 1951, and since 1951 for Oak Ridge National Laboratory. In these two contracts, I was chiefly concerned with the theory of the shielding of reactors.

Since the end of the War I have been a member of several committees of the United States Government. They included the Committee on Atomic Energy of the Research and Development Board of the Department of Defense,

from 1952 to 1954, the Nuclear Panel of the Scientific Advisory Board to the U. S. Air Force from 1953 to 1954, and the Scientific Advisory Committee to the Office of Defense Mobilization at present, in addition to minor committees.

I have continued my teaching and my research in pure physics at Cornell University. From September 1955 to July 1956, while on leave from Cornell University, I was Visiting Professor of Physics at the University of Cambridge, England. During this time, I had an opportunity to study the British Atomic Energy effort, in particular on the fast breeder reactor. I was a member of the United States' team to exchange information on the fast reactor with the United Kingdom. I was also a member of the U. S. delegation to the Geneva Conference on Peaceful Application of Atomic Energy in August 1955.

Since 1953 I have been a consultant to Atomic Power Development Associates, Inc. (APDA), and the Study Group which preceded it. This group was first known as the Dow-Detroit Edison Study Group, and then was reorganized as APDA. Pursuant to a contract between APDA and Power Reactor Development Company (PRDC), APDA provides nuclear and other technical services to PRDC. I understand that this contract between APDA and PRDC is included in the PRDC Application for License as Exhibit XXI. In connection with my work for APDA, I have become generally familiar with the proposed design for the Enrico Fermi Reactor, as set forth in APDA-115, included [fol. 3955] as Exhibit XA to the PRDC License Application, as amended. I have worked on some phases of this design as an APDA consultant, and in particular on problems related to its safety and the testing of its safety. In connection with this work, I have become familiar with the work of Argonne National Laboratory on fast reactors, and with the theoretical work of Nuclear Development Associates, Inc. (NDA) in White Plains, New York on the same subject. I have read the testimony to be given in this proceeding by Dr. Norman Hilberry of Argonne National Laboratory, as well as that to be given by Mr. A. Amorosi, Mr. Walter J. McCarthy and Mr. Kenneth Davis.

(2) *Principles of Fast Reactors*

A reactor is a device in which the energy of the fission of uranium is converted into heat. In a power reactor this heat is removed in such a way as to permit further conversion into electricity by a conventional generator.

The most important ingredient of a reactor is the atomic fuel which is U^{235} in practically all the reactors so far constructed. In the future, plutonium and U^{233} may also be used as reactor fuels. The reactor works by means of neutrons which cause fission in the U^{235} nuclei. The power produced is directly proportional to the rate of this fission. When no neutrons are present in the reactor, no power will be produced.

In each fission of U^{235} about 2.5 neutrons are set free from the nucleus. Some of these neutrons leak out of the reactor, others are captured in the structural material or in the coolant, some will be captured by another nucleus of U^{235}. A certain fraction of the neutrons captured in U^{235} nuclei will cause another fission. If, on the average, one of the neutrons emitted in each fission causes another fission, a self-sustaining chain reaction will result; the number of neutrons will then remain constant, and the power will be steady.

[Tel. 3956] In general, this will not be exactly the case. We define the multiplication factor k which is the number of fissions produced on the average by the neutrons originating from one fission. If $k = 1$, the power is steady. If k is greater than one, the number of fissions in the next generation will be greater than that in the last generation and the power will increase with time. If the multiplication factor k is less than one, the power will decrease with time. The difference $k - 1$ is often called the reactivity or sometimes the excess reactivity of the reactor, and is often denoted by Δk.

The reactivity is controlled by control rods. Three different ways have been proposed and used for controlling a reactor. The first is to vary the amount of fuel in the reactor, i.e. to have some fuel rods which can be moved in and out of the reactor. The second method is to have rods made of a substance which absorbs neutrons strongly, these are called poison rods. Finally, part of the reflector may

be made movable, this then controls the leakage of neutrons from the reactor.

The most common type of control is by poison rods. When such a control rod is inserted into the reactor, more neutrons will be absorbed by it, fewer neutrons will be available to make fission in U^{235} and hence the multiplication factor will drop. The control rod works like a combination of brake and accelerator in an automobile, and just as a car can be accelerated or decelerated at will, so the power of a reactor can be regulated by the control rod. The ease with which the reactors I have seen respond to controls is most impressive.

By the fission of U^{235}, energy is developed. This energy heats the fuel U^{235}. This heat is taken away by the coolant, which is normally a fluid circulating through the reactor. Most of the reactors so far built are cooled with water. Some are cooled with liquid sodium, including the proposed [fol. 3957] PRDC reactor. The sodium will in turn give its heat to water which is thereby transformed into steam, and the steam drives the electric generator. In several designs, including the PRDC design and that of EBR-II, which is to be constructed by Argonne National Laboratory, the transfer of heat from sodium to water is not done directly but through an intermediate heat exchange fluid as an added precaution to prevent release of radioactivity as a result of a chemical reaction between sodium and water.

The proposed PRDC reactor is a fast reactor. This name refers to the speed of the neutrons in the reactor. The neutrons come out of a fission with speeds of about ten thousand miles per second. In some types of reactors they are permitted to collide many times with atomic nuclei, and in each such collision they lose some of their speed, until their speed is reduced to about one mile per second. They are then called thermal neutrons, and reactors in which this process goes on are called thermal reactors. In a thermal reactor most of the fissions are caused by thermal neutrons, and only very few neutrons are able to cause fissions while they are fast. The substance which slows the neutrons down from ten thousand to one mile per second is called the moderator. The best moderators are materials which contain many nuclei of low atomic weight such as hydrogen or carbon, i.e. materials like water or graphite.

In a fast reactor the use of a moderator is avoided as far as possible. Then the neutrons remain fast and will make fissions while their speed is still several thousand miles per second rather than one mile per second. In order to accomplish this all materials containing hydrogen are kept away from the reactor core. This is one of the main reasons why sodium is used as a coolant. Even the amounts of sodium and of structural materials like stainless steel in the reactor core are kept to a minimum, in order not to slow down the neutrons.

[fol. 3958] The purpose of keeping the neutrons fast is to accomplish breeding. This means that the reactor regenerates its own fuel, and if possible produces additional fuel. In order to accomplish this, the materials in the reactor must be so arranged that most of the neutrons which do not cause fission are captured in the common isotope of uranium, U^{238}. If this happens, U^{238} is converted into plutonium which is a very good atomic fuel. This conversion is the process by which plutonium is produced in the big Hanford and Savannah River reactors of the Atomic Energy Commission. However, in these reactors, which are not fast reactors, less plutonium is produced than U^{235} is consumed. It has been shown, both by calculation and by experiment, that in a fast reactor the production of plutonium will be greater than the consumption of U^{235}. Ultimately when plutonium can be used as a fuel for a fast reactor, one hopes to produce in a breeder at least 1.5 plutonium atoms for each plutonium atom used up as fuel. Such a breeder would then be like a coal furnace which makes more coal than it uses up.

It is clear that a breeder will be of the utmost importance for a large scale atomic power economy. It is likely that in 30 to 50 years, a large fraction of our power will be derived from atomic energy. This will only be possible if the supply of atomic fuel is very great. Breeders seem to me indispensable for this purpose. Since power demands increase constantly and at a rapid rate, a very large supply of atomic fuel will be required.

Indeed, one of the most compelling reasons for developing atomic power is to extend our fuel reserves. We hear that our natural oil supply will become insufficient in two or three decades, and that coal reserves, although much

larger, are also limited. Atomic power was discovered just in time to prevent serious worry about our fuel reserves. However, if we use only the isotope U^{235} which is directly fissionable, then all the uranium reserves now known to [fol. 3959] exist in the world will give *less* energy than the known reserves of coal. This is because U^{235} is only .7 per cent of the uranium we find in nature. If we learn to use breeders we can use *all* the uranium instead of just the U^{235}, because a breeder will convert the non-fissionable but fertile material U^{238}, which constitutes 99.3 per cent of natural uranium, into the fissionable material plutonium. This will extend the supply of atomic fuel more than a hundredfold. Only if we succeed in doing this will atomic energy give us a real improvement in our fuel reserve; in this case the uranium reserves will outlast the reserves of our fossil fuels more than 50 times. The development of breeders is, therefore, a most important measure of conservation of our precious atomic fuel.

Other countries have fully recognized the importance of breeders. This is particularly true of Great Britain, which has the greatest need for atomic power because of the high cost of mining coal from partly exhausted coal fields and because of an actual shortage of coal which goes hand in hand with this. Britain has therefore taken the lead in the actual construction of atomic power reactors, and in its program is including fast breeders in an important way. They started their breeder development in 1951, and are now expecting to put a full scale breeder reactor into operation in 1958. This means that they are now several years ahead of our development in this field. Even little Belgium is thinking seriously of the development of breeder reactors. In the United States, we had an initial lead in this field. The Argonne National Laboratory built an experimental breeder reactor of about 1000 kilowatts power as far back as 1950. This reactor, EBR-I, has given much scientific information, and in particular, has definitely established that breeding is possible. But high power breeders will not be completed for several years. As I have already mentioned, Argonne is planning another breeder, EBR-II, this one to be of intermediate power. The only full scale power breeder

on which design has progressed substantially, however, is [fol. 3960] the proposed PRDC reactor.

The construction of this plant, and the simultaneous research and development program of APDA, and of the U. S. Atomic Energy Commission, will help to restore to the United States the leadership in this important section of the atomic power program, and will substantially extend the frontiers of technical knowledge in this area. The simultaneous pursuit of programs of research, development and construction has become standard in the fast-moving field of atomic energy and is necessary in order to keep abreast or ahead of our competitors. The expeditious construction of a full-scale breeder is in my opinion an essential step in any large-scale program of developing economically feasible nuclear power.

(3) *Hazards*

The mere construction of a reactor without the introduction of nuclear fuel involves no hazard to the public, since such construction is performed in the same manner as the construction of any building, industrial plant or power plant. No possibility of the creation of any nuclear hazard exists until nuclear material is present. I can envisage no danger to the United States or its security arising from the construction of a reactor plant.

After nuclear fuel has been introduced into the nuclear reactor and the reactor is put into operation, it is still impossible that the reactor ever explode like an atomic bomb. There is no way in which this could ever happen. The hazards we are speaking of in nuclear reactors do not lie in any violent explosion, but in the possibility that the radioactive fission products which have been formed by the operation of the reactor get released into the atmosphere and thereby cause a radiation hazard for the surrounding area. [fol. 3961] When we talk about these hazards, we must have clearly in mind that we are talking about extremely remote possibilities. The probability of nuclear accidents leading to dangerous release of radioactive substances from a reactor is incomparably smaller than that of the most freakish accidents we occasionally read of in the newspapers and very much smaller than that of the rarest diseases. The

reason why accidents to reactors are so improbable is that they are designed in such a way that one failure, such as carelessness of the operator or failure of one mechanical component of the reactor, by itself can never lead to an accident. Of course, every mechanical component is designed and built with the greatest of care, and the operators are highly trained and competent. But still, an oversight by the operator will not by itself lead to an accident because mechanical devices will take over and insure safety, and the failure of the mechanical component will not cause trouble, since other mechanical devices will still operate and shut the reactor down if necessary. Only if two or three, or in important cases even more, major failures occur simultaneously is there even a chance of an accident. Since each component has only a very small chance to fail, because of its careful construction, the simultaneous failure of several independent components is almost unbelievably small. We have, as it were, in each situation several strong and independent lines of defense.

As I have said, the hazard of nuclear reactors is due to the radioactive substances in it. Their presence arises as follows. In the fission process the uranium nucleus splits into two smaller nuclei. Most of the resulting fission fragments are radioactive, that is, they change into still other nuclei in the course of time and in doing so they emit radioactive rays. The hazard potential in a reactor is, therefore, [fol. 3962] determined by the amount of fission products which are contained in the reactor. This amount depends primarily upon the power of the reactor. The reactor which PRDC proposes to build has only moderately high power, 100,000 kilowatts of electrical power or 300,000 kilowatts of heat. At least one other reactor whose construction has been approved will have more than twice this power.

The amount of fission products in a reactor does not depend on the mass of U^{235} in the reactor. This mass is indeed high in a fast reactor. In the PRDC reactor, for instance, it will be about 485 kilograms or a little over 1,000 lbs., which is about twice as much as in a thermal reactor of similar power working with enriched and solid fuel. However, this is compensated (for the present consideration) by the fact that at any given time there are fewer radio-

active fission product nuclei per pound of U^{235} in the fast reactor. In fact, if a reactor is operated for a very long time—many years—always at the same power, and if none of the fission products are removed, then the total amount of radioactivity in the reactor will depend only on the power at which it has been operated, and will be proportional to that power. Even the distribution of fission products among various chemical species is nearly the same for a fast as for a thermal reactor, and the small existing differences have no influence on the hazard.

Actually, the fuel elements from a reactor are unloaded periodically, and are reprocessed chemically to remove the fission products. The used-up fuel elements are replaced by fresh ones in a reloading process. In a fast reactor, the reloading period is usually relatively short; in the PRDC reactor, for example, it is planned to reload and replace some of the fuel elements every week, and any given fuel element will stay in the reactor only about 12 weeks. This means that some of the long-lived fission products will be [fol. 3963] present in much smaller amounts than in a reactor which is reloaded less frequently, as is often the practice in thermal reactors. These long-lived fission products, and especially strontium-90 which is among them, are generally considered particularly harmful biologically, and keeping their concentration down will reduce possible hazards. Thus, the PRDC reactor will actually contain slightly lesser amounts of dangerous fission products than a typical thermal reactor of the same power. But the main point is that a fast reactor does not contain any more fission products, or any more hazardous fission products, than a thermal one.

In normal operation of any reactor the fission products are enclosed within the reactor and cannot escape. Their radiation cannot get out even into the building surrounding the reactor, let alone to the surrounding country. This protection from radiation is generally accomplished by a shield made of concrete and iron or lead or other material which is especially designed to prevent radiation from escaping. A large amount of knowledge exists on shield design, and substantial protection can be afforded by a properly designed shield. In my opinion, the shield prepared

for the PRDC reactor is conservatively designed and no fundamental question exists as to its functional safety.

The only hazard, then, could come from a release of the fission products from their normal confined location in the uranium inside the reactor. Protection against this can be provided by adequate containment; fission products can be released only if the several containing vessels which usually surround the reactor were to break in succession. For example, in the proposed PRDC design, as disclosed in the License Application as amended, the reactor itself is enclosed in the reactor vessel, a strong steel vessel which will stand up under considerable pressure. Outside this is the graphite primary neutron shield which is surrounded by [fol. 3964] the primary shield tank, again of steel. A heavy concrete and steel biological shield surrounds the primary shield tank and the entire system is located in the reactor compartment, a sealed region filled with an inert gas. The reactor compartment is below the operating floor of the reactor building, and the outside wall of this building consists entirely of a strong steel shell.

The primary containment is by the reactor vessel, and every precaution is taken to design this vessel with the greatest care. Precautions are taken against a large number of conceivable causes for its mechanical failure. One of these might be heat shock, i.e., sudden change of temperature of the sodium coolant; elaborate precautions are taken against this affecting the vessel. Another cause of trouble might be chemical action between sodium and water; strong safeguards are taken against this. Mechanical shock might be still another and this also is guarded against.

Of course, none of these various conceivable causes of failure of the reactor vessel is peculiar to a fast reactor. Heat shocks may occur just as easily in water-cooled thermal reactors as in fast reactors. Also, sodium cooling is not peculiar to fast reactors but has been used in intermediate-energy ones and is being incorporated in some thermal reactors, due to its great advantages for heat transfer. There is still another possible cause for failure of a reactor vessel, namely, high pressure inside it, combined with mechanical fatigue of the material of the vessel: many thermal reactors, especially the pressurized

water reactor, use high pressure, while fast reactors, including the PRDC reactor, do not. In short, the possible non-nuclear causes of failure are present in thermal as much as in fast reactors, and in some cases more so. Failure due to nuclear accident is in my opinion far less likely than any of the improbable non-nuclear events which I mentioned. Of course, nuclear accidents also can be conceived for ther- [fol. 3965] mal as well as for fast reactors; their discussion will form the main part of my testimony.

Even if the reactor vessel in a fast reactor of the type proposed by PRDC should be breached, the fission products will not be released to the outside. In the first place, the fission products are still enclosed in the fuel elements themselves. These fuel elements must lose their integrity, by melting, burning, or crumbling into small fragments, before the fission products can escape.

Some fuel elements, more or fewer, according to the type of accident, may, of course, disintegrate and release their fission products. But we must remember that most of the fission products are solid or liquid at normal temperatures. These liquids or solids will then merely be sprayed over the primary shield. Some fission products are gases. These, in case of a breach in the reactor vessel, will still be contained in the primary shield tank, and if this also fails, in the gas-tight reactor compartment. It would be very difficult for them to find their way up to the operating floor of the reactor building. If they did, or if the reactor compartment were to break also, the fission gases would still be in a confined space, namely the reactor building.

To prevent them from escaping from this building, we have the last and strongest line of defense, the steel shell of the reactor building itself. This steel shell is made gas tight and thus can contain the gaseous fission products. Therefore, even if the reactor vessel, the primary shield tank and the reactor compart ent should be breached this will not cause a hazard to the surrounding country but will merely make the reactor building inaccessible for a number of weeks or months.

The gas-tight shell of the PRDC reactor building is made of steel so that it can withstand some pressure. This is to [fol. 3966] provide for the remote possibility that the

sodium in the reactor might burn if the reactor vessel breaks which would heat the air in the building and thus increase the pressure. Even if all the sodium were to burn, the steel shell is designed to contain the residual air and the fission gases.

[fol. 3967] (4) *Nuclear Accident.*

One of the improbable events which might release fission products from a reactor is a nuclear accident. This could come about if the power of the reactor were suddenly to exceed the normal power by a large amount. Due to the excess of power, the fuel elements would heat up; they might then melt and the coolant might vaporize.

Such nuclear accidents can come about by a malfunctioning of the reactor control. As I mentioned before, a reactor has control rods which are moved mechanically and which determine the multiplication factor k. If the control rods are set in such a way that k is greater than one, then the number of neutrons and the reactor power will increase and if this increase is not stopped, an accident could occur.

There are many safeguards built into all reactors so that this cannot happen. Perhaps the most important is the power scram mechanism. When the power exceeds a certain level which is previously determined, then an automatic device will shut down the reactor. That is, the device will cause certain control rods to move rapidly into the reactor. This, as we have said, will decrease the multiplication factor k below one and thus lead to a quick drop in the reactor power.

These special control rods which can be rapidly pushed into the reactor are called safety rods. In the PRDC reactor, for example, they will be normally suspended above the reactor core by means of an electromagnetic clutch. When the scram signal comes, the magnetic clutch is released and the safety rods drop into the reactor. If for some reason the apparatus does not function properly, for instance, if there is a power failure, the magnetic clutch automatically ceases to operate, the safety rods drop into the reactor and the reactor is shut down. In other words, [fol. 3968] any failure in the system will lead to increased safety, the safety rods fail safe.

The power scram mechanism on a reactor is set at a power level which may be some 20% higher than the normal operating level, and some 20 to 50% lower than the power level at which fuel elements would melt. Safety rods are, of course, frequently tested to insure their continued safe operation.

Why is it necessary to ever let the multiplication factor k become greater than unity? We must permit such excess reactivity (k greater than one) in order to get the reactor started. When the reactor has been shut down for any reason, its power has to increase again from a low value to the operating level. This requires reactivity greater than one.

The higher the excess reactivity $k - 1$, the faster will the power of a reactor increase. The rate of increase of power is measured by the time which would be necessary to have the reactor power increased by a factor of about 2.7; this we call the period of the reactor. When the reactor is started up, this period is in general kept at a minute or more by suitable setting of the controls, but it may also be hours or it may be as short as seconds. It is a possible hazard to let the reactor power increase too fast because we might thereby lose control. For this reason another safety device is ordinarily provided on reactors which prevents the period from becoming too short. For instance, we may decide that we shall never operate at a reactor period shorter than ten seconds. In this case, a second scram device is provided which shuts the reactor down if its period becomes shorter than ten seconds. This is called the period scram in contrast to the power scram discussed before.

Properly designed scram devices have always worked in the history of reactors. Even in the few instances when small accidents have occurred in reactors, such as in the accident of the experimental breeder reactor EBR-I of [fol. 3969] the Argonne National Laboratory, the power scram apparently worked. However, in this EBR-I accident, the period scram had purposely been disconnected in order to perform a certain experiment which will be discussed in more detail later on. For this reason, the period was permitted to become as short as one second, correspond-

ing to a value of k considerably in excess of one. Now there is necessarily a delay between the power scram signal and the actual movement of control rods which substantially reduces the reactivity of the reactor. This delay is usually a second or so, and if the period itself is as short as a second, then the power will have increased considerably beyond the scram power by the time the reactor is actually shut down. For this reason, the EBR-I overheated and its core was partly melted, as described in more detail by Dr. Hilberry in his testimony.

However, if there is a period scram set e.g. at ten seconds, such an overshoot of the power cannot happen. Power will then never rise very fast, and during the delay from the scram signal to the actual shutting down of the reactor, the power will not rise appreciably. This hazard can be further minimized by making the delay from signal to shutdown as short as possible. For example, in any power reactor the period scram will be set at such a period that it will be entirely safe from overshoot of the power. Power reactor operators will never do any experiment in which they eliminate the period scram. The PRDC reactor, for example, will have a safe power scram set at a safe power level, and a period scram set at a safe period, and this combination seems to me to provide very real assurance of safe operation.

A further safeguard in the control of reactors which is incorporated in the PRDC reactor is that the control rods [fol. 3970] which are used by the operator to control the reactor power, as well as the safety rods, can be removed from the reactor only very slowly. Thus reactivity can increase only very slowly. This is in contrast to rapid insertion of the safety and control rods which can *decrease* the reactivity very rapidly. Mechanical means thus insure that all motions which lead to higher power and thus to hazard will be carried out slowly, while all motions leading to greater safety take place very fast once they are started. Slow increase in reactivity has the advantage that the measuring instruments can follow the power and the reactor period very easily and that there can be no overshoot.

There is no difference between the control of a fast reactor and the control of a slow reactor. Perhaps dif-

ferent materials and a higher volumetric concentration of poison may be used in a fast reactor than in a thermal one. However, the reactor periods which are involved are the same in both cases; they are of the order of seconds or minutes, and do not depend on the speed of the neutrons.

The reason for this is that some of the neutrons that are emitted in fission do not come out of the nucleus immediately but are delayed by times varying from about a second to about a minute. The control of a reactor, either thermal or fast, depends essentially on these delayed neutrons. In the case of U^{235} about .75% of all the neutrons emitted in fission are delayed.

If the multiplication factor k is exactly one, the chain reaction will be self-sustaining, but this will be true only if we use all the neutrons, including all the delayed ones. If we raise the multiplication factor k above one, we need less and less of the delayed neutrons. Finally, if k becomes about 1.0075 the delayed neutrons are no longer needed. For in this case it suffices to use 99¼%. of the neutrons, those which are emitted promptly, and we shall still get as many neutrons in the next generation as in the last, and [fol. 3971] thus be able to sustain the chain reaction. Thus, for k=1.0075, a reactor is critical with prompt neutrons alone, and this condition is called prompt critical.

It is imperative to keep a reactor always below prompt critical, and reactor controls must operate chiefly in the region between the ordinary critical condition, called delayed critical, and prompt critical. For convenience, reactor scientists have called the interval from delayed critical to prompt critical one dollar. This dollar is used as the unit of reactivity and corresponds for U^{235} fuel to an interval of 0.0075 in k. This interval is subdivided into a hundred "cents". Thus a reactivity of 10 cents means a multiplication factor of k of 1.00075. Ordinarily reactor controls are set at no more than a few cents of reactivity.

There is a definite relation between reactivity in cents and the reactor period. For instance, one cent of reactivity corresponds to a reactor period of about 20 minutes. In general, this relation is expressed by a rather complicated mathematical formula known as the in-hour equation. This equation depends almost entirely on the prop-

erties of the delayed neutrons and is very nearly independent of the speed of the neutrons which cause the fissions. This statement is accurate to a small fraction of one percent at the low excess reactivities at which reactors are normally operated. But even if the reactor period were to get as short as one second, the corresponding excess reactivity is 75.5 cents for a fast reactor, and 76.0 cents for a rather slow thermal reactor. For this reason reactor control is the same for fast and for thermal reactors.

Only if a reactor were permitted to operate very near to or above prompt critical would there be any influence of the speed of the neutrons. In this case indeed the power in a fast reactor would increase more rapidly with time than [fol. 3972] that of a thermal reactor. However, no reactor is ever operated above prompt critical. In the operation of the PRDC reactor, excess reactivity will be limited at the most to about 70 cents, and will never be allowed to even approach the dollar which would make the reactor prompt critical and thereby hazardous.

As a matter of fact, it is perfectly feasible to design a reactor in such a way, and to load it with fuel in such manner that it will be impossible for the operator to increase the reactivity to a full dollar or close to it even if he were to forget all rules of operation. This safeguard can be applied in addition to period scram and power level scram, and, in fact it will be incorporated in the PRDC design. We simply shall not have a dollar excess reactivity available.

We are able to incorporate this safety feature because of the special properties of a fast reactor. The main property is that the fuel in the reactor burns up very slowly, because the critical mass is so large and the power per unit mass not particularly high. Now in the PRDC reactor, fuel will be reloaded every week, and between two such reloadings only about .5% of the fuel will burn. It is conservatively estimated that this burn-up, together with all accompanying changes like the accumulation of fission product poisons, will consume less than 42 cents of reactivity. It is planned to provide an additional 30 cents as a control margin for the operator. This means that even directly after reloading no more than 72 cents of excess reactivity

are available anywhere in the reactor once it is at the operating temperature even if all the control rods and safety rods are withdrawn. As I have shown, up to 72 cents and somewhat higher, there is no appreciable difference between the behavior of a fast and of a thermal reactor. No conceivable failure of either the mechanical devices or the operator can bring the reactor to prompt critical; once it is operating after completion of a reloading.

[fol. 3973]

Thermal reactors require far greater provisions of excess reactivity. This is because the fuel in these reactors burns relatively faster since the total amount of fuel initially provided is lower than that in a typical fast reactor. Hence at the same power level a thermal reactor has a greater rate of reactivity change due to fuel burn-up than a fast reactor.

More serious than this fact for the control of thermal reactors is the nuclide Xe-135. This nuclide is a fission product which has an enormous capture cross section for thermal neutrons, but almost none for fast neutrons. In a reactor operating at high power, large amounts of this nuclide will be present which will greatly decrease the reactivity. On the other hand, before the reactor has operated, Xe-135 will not be present. Therefore, in this "clean" state a large amount of excess reactivity has to be provided so that it can then gradually be given to the reactor as the xenon-135 builds up. For thermal reactors of high power, ten dollars or more of excess reactivity must be available for this xenon over-ride. No nuclide of similar properties is expected to exist in the case of fast reactors; for these reactors, all nuclei will have more or less the same cross section, and unusually high cross sections are impossible by the laws of nuclear physics. Therefore, it will not be necessary in a fast reactor to provide large excess reactivity when the reactor is clean for the purpose of overriding the absorption of some nuclide when the reactor is filled with fission products. From this very important standpoint then, a fast reactor can be made safer than a slow one.

[fol. 3974]

(5) *Special Hazards in Fast Reactors*

I believe, therefore, that a fast reactor of the general type proposed by PRDC can be designed and operated

safely. However, there have been some adverse statements made about the safety of this reactor type, and I believe such statements are based on certain nuclear characteristics of a fast reactor which are not found in a thermal reactor. There are three main characteristics of this type.

1. Probably the most important of these lies in the fact that if ever the reactivity becomes greater than prompt critical, the power in a fast reactor will rise with a faster period than in a thermal one. I have explained before that this is not the case as long as the reactor stays below prompt critical, and that many independent precautions are taken to assure that a reactor never gets beyond prompt critical or even near it.

Although I see no way in which prompt critical can ever be exceeded in a reactor such as that proposed by PRDC, we are nevertheless, prepared to consider what could happen if through a completely unforeseen combination of circumstances, we should exceed prompt critical.

In this case indeed a fast reactor would heat up more rapidly than a thermal one, and a nuclear accident would occur. However, even if prompt critical were exceeded this does not result in an explosion which in any way would be comparable to an atomic bomb. In order to obtain an atomic explosion, one has to raise the reactivity of the fissionable materials in the atomic bomb very suddenly to a high value; in fact a reactivity of perhaps one hundred dollars has to be reached in a few millionths of a second. Moreover, even then a bomb explosion will not result if a large number of neutrons is present to begin with, as will be the case in an [fol. 3975] operating reactor. In short, it is extremely difficult and requires special designs to make an atomic bomb, and one cannot obtain an atomic bomb by accident. The high level of neutrons in a reactor is in itself an absolute guarantee that no atomic bomb explosion can ever result.

If a reactor ever has an accident, this can be, at the worst, comparable to a boiler explosion in a conventional power plant. Its severity depends primarily on the *rate* at which the reactivity increases beyond prompt critical. Now, all the motions of control rods in reactors are designed in such a way that reactivity can increase only at a very slow rate. For example, in the PRDC design, an increase of 1¢

per second is the most that the mechanism will permit. APDA has carried out calculations with which I am familiar, to determine the course of the accident which would result if all scram mechanisms were to fail and reactivity were to be inserted at the rate of 1¢ per second, even beyond prompt critical. These calculations have shown that in this case the natural thermal expansion of the uranium in the reactor would automatically shut down the reactor even though prompt critical was exceeded. In other words, even if all shut down mechanisms were to fail, the natural behavior of the uranium when heated would prevent an accident. We would merely get some rise in temperature which would subsequently die down.

Another calculation with which I am familiar was made in which the reactivity was allowed to increase 1000 times faster, at $10 per second; although I cannot conceive of any movement of the controls which would make the reactivity increase at anything near that rate. This calculation was carried out by Nuclear Development Corporation (NDA) at White Plains, N. Y., a nuclear consultant to APDA. The result of this calculation was that even this rapid increase of reactivity would not lead to serious trouble, and would [fol. 3976] presumably not burst the reactor vessel.

2. The second special nuclear characteristic found in fast reactors is that their reactivity would increase if moderators were introduced into the reactor. For instance, if sodium in a fast reactor coolant system were partially replaced by some material containing hydrogen—for instance oil or water—the reactivity would increase. If this were done to an appreciable extent, the reactivity might increase beyond prompt critical. Exclusion of moderators from a fast reactor system does not, however, present any insoluable problems. In the PRDC reactor, for example, there is no conceivable way in which oil or water might get into the sodium system which is completely sealed. To make doubly sure, water is to be completely excluded from the reactor building—there are no drinking fountains, no wash-stands, nothing else containing water in the building. Oil and grease are kept to an absolute minimum; there are no reservoirs of lubricants as are common with large motors, but each piece of equipment which requires it is lubricated only by a small cartridge of lubricant.

Thus only very small amounts of hydrogeneous material are available anywhere in the building, and these small amounts cannot get into the sodium system. Nevertheless, NDA has also carried out calculations with which I am familiar about the effect of substituting moderator for sodium in the PRDC reactor. Even making unduly pessimistic assumptions, no serious accident resulted unless an immense amount of moderator was introduced, and I consider this incredible.

I am acquainted also with what I consider to be a somewhat more realistic calculation, made by APDA, which envisaged the possibility that suddenly the sodium entering the reactor was 100 degrees cooler than the sodium normally entering. However, this should come about, I cannot con- [fol. 3977] ceive, but this possibility again did not lead to a nuclear accident.

3. A third relevant characteristic of fast reactors is the large amount of rather highly enriched fissionable material contained in them. If all this material in the PRDC reactor, for example, were assembled in one solid ball, and then surrounded tightly by a good neutron reflector such as solid natural uranium, we would have about six times a critical mass. If brought together suddenly, such a large amount of material would explode—but as I have pointed out already, with nothing remotely resembling the force associated with an atomic bomb. Thermal reactors of equal power working on enriched U^{235} contain less U^{235} and therefore do not involve this hazard, especially if the U^{235} is not highly enriched. In fast reactors, only the geometric dispersion of the fuel for cooling purposes prevents the reactor from being supercritical. For this reason, it is essential to make sure that the fuel in a fast reactor can never assemble in one large mass. It is feared that such an assembly might result if a fast reactor melted down. At present, APDA, Argonne, and others are conducting very thorough investigations to make sure that any conceivable melt-down will not lead to the assembly of a large volume of enriched uranium.

Of course, every precaution is taken in any well-designed fast reactor (such as the PRDC reactor) so that even the

first part of this hypothetical accident, namely, the melting down of the uranium, will never occur. I have discussed some of these precautions before and will discuss others later on. However, it is argued, the experimental breeder reactor EBR-I *did* partially melt down, in an incident in November, 1955, and this incident has caused most of the fears concerning fast reactors. It is my sincere belief that these fears are groundless and that the causes which made the EBR-I melt down will not exist in the PRDC reactor. [fol. 3978] This is because the structure of the PRDC reactor will be different from EBR-I, and the reactor will be operated in a different manner. I shall discuss these differences further in this testimony.

4. Finally, a fourth characteristic relevant to safety is sometimes attributed to fast reactors and not to slow ones as a class. This is the observation that EBR-I had a positive temperature coefficient of reactivity which was the immediate cause of its accident and it is sometimes argued that a positive temperature coefficient might be a general feature of fast reactors. I do not believe that this is the case, and I shall give my reasons for this opinion in the next section in which I shall also explain the meaning of the term positive temperature coefficient.

The positive temperature coefficient and the consequences of a possible melt down of a fast reactor are problems which do require further experimental and theoretical study. In the next three sections of this testimony, I shall deal with the studies which have already been made on these problems, and with those which are now being conducted and are planned for the coming months. In my opinion, this work will establish that coefficients of reactivity and melt down problems in fast reactors do not render this type of reactor hazardous for operation in populated areas.

To summarize, there are many safety features of reactors. They include well-trained operators, good instrumentation, many independent automatic shut-down mechanisms, control systems designed to fail safe, a sealed-up coolant system, and many independent, strong containing vessels. There are some features peculiar to fast reactors which tend to make them even safer than thermal ones, e.g. that the system is at low pressure, that the reloading cycle of the

fuel is short, and especially that only a very small amount of excess reactivity needs to be provided because there is no [fol. 3979] need for xenon override. Taken all together, it is my opinion that on the basis of present knowledge there is as much assurance of designing and operating a fast reactor safely in a populated area as there is of designing and operating a thermal reactor, with the sole possible exception of the two areas of temperature coefficient and melt down which are still being examined both theoretically and experimentally. It is my further opinion, that a fast reactor can be so designed and constructed as to provide adequate safeguards in these two areas, and that the theoretical and experimental work now underway in these fields will confirm this.

(6) *Temperature Coefficient*

It is generally true that an increase in the temperature of a reactor will lead to an expansion of the fuel and of the rest of the reactor, and that this expansion will decrease the reactivity. If this is the case, we say that the reactivity has a negative temperature coefficient. In calculating the effect of mild accidents, e.g. in the calculations of APDA and NDA which I mentioned before, a negative temperature coefficient is generally assumed and its value is calculated from the known thermal expansion of uranium and the other constituents of the reactor. If the normal mechanical safety devices of a reactor should fail, the negative temperature coefficient is the chief mechanism which prevents severe accidents.

Unfortunately, the EBR-I accident in November, 1955, which I mentioned before has shown that the EBR-I reactor had a positive temperature coefficient. The power and the reactivity were carefully recorded during the course of the accident and there is no doubt that the reactivity of EBR-I increased as the reactor heated up. In fact, it had been known for more than two years before the accident that EBR-I had a positive temperature coefficient. Clearly, the positive coefficient was the direct cause of the accident [fol. 3980] of November, 1955: as the power increased the reactivity of the reactor increased, which then led to an even faster rise of power, and so on.

Obviously a positive temperature coefficient cannot be tolerated. Its existence had given grave concern to the scientists at ANL, APDA and NDA ever since it was discovered, and the experiment of November, 1955, which led to the accident was part of an extended program to find out more details about the positive temperature coefficient and, if possible, to determine its cause. A further program for investigating its cause and possible cure is well under way.

It is necessary to qualify the statement that the EBR-I had a positive temperature coefficient. Actually, if the *whole* reactor was heated slowly, the reactivity of EBR-I decreased as it does for all reactors I know. The positive coefficient was observed only if the fuel was heated very rapidly so that there was no time for the sodium coolant to carry the heat away. We therefore say that the *prompt* temperature coefficient is positive; on the other hand, if one waits long enough, the total temperature coefficient is negative. Therefore EBR-I behaved all right in normal operation. Indeed, EBR-I was operated for four years without any trouble, and many experimental results were obtained from it. Only when a special experiment was made in which the operating conditions were entirely different from those in normal operation and in which the reactor was purposely put on a fast rising period by inserting considerable excess reactivity, then the prompt coefficient came into play which finally led to the accident.

The fact that in this case we have to do with a prompt temperature coefficient shows immediately that this coefficient must be associated with the temperature of the fuel itself. The question arises now whether the positive [fol. 3981] temperature coefficient is in any way peculiar to fast reactors, and whether perhaps it is unavoidable in fast reactors. I am confident that this is not the case.

It is true that an effect exists which *could* give a positive contribution to the temperature coefficient in EBR-I and which *is* characteristic of fast reactors: This is the so-called Doppler effect. Investigations on this effect have proceeded for almost ten years, mostly at the Knolls Atomic Power Laboratory at Schenectady. However, that Laboratory was primarily interested in intermediate reactors in which the neutrons are neither thermal nor fast. For fast

reactors, the first thorough theoretical treatment of the Doppler effect was given two years ago by Dr. Goertzel and his associates at NDA. I am familiar with their calculations and in fact followed this work very closely due to its extreme importance. Their main results were, first, that the temperature coefficient due to Doppler effect is very small and second, that it depends critically on the dilution of U^{235} with U^{238}. In EBR-I in which nearly pure U^{235} is used, the Doppler effect may indeed cause a small positive temperature coefficient. But if U^{235} is diluted with at least one atom of U^{238} per atom of 235, then the Doppler effect will give a negative temperature coefficient. In the PRDC reactor, for example, there will be about 3 atoms of 238 per atom of 235, and this will make the Doppler coefficient certainly negative and its value somewhat larger than for EBR-I. Therefore, according to the best theoretical information now available, the Doppler effect can be made to contribute to safety in fast power reactors and will do so in the PRDC reactor.

Even in the EBR-I, the Doppler effect cannot have been the cause of the observed positive temperature coefficient. [fol. 3982] According to my own latest calculations, it could have contributed no more than 5% of the observed positive temperature coefficient.

Experiments are under way at Arco, Idaho, to measure the Doppler coefficient in a critical assembly, ZPR-3, which contains the same materials as EBR-I. A critical assembly is a reactor which operates at extremely low power, perhaps a few watts, a condition which is particularly suitable for exact measurements of the reactivity. The experiments so far carried on have given the result that the Doppler effect may be even smaller than the calculated value, certainly not larger. These difficult experiments are continuing, and are discussed by Dr. Hilberry in his testimony. At present they give confidence in the theoretical calculations and confirm the conclusion that the Doppler effect cannot have been responsible for the positive temperature coefficient in EBR-I; and will certainly not give a positive temperature coefficient in the PRDC reactor.

The experiments prove in fact somewhat more. The experimental fact is that the heating of a piece of U^{235}

by itself, without heating the rest of the reactor, does not cause a measurable increase in reactivity, as long as the uranium does not move. This excludes not only an undesirable Doppler effect but means that there is also no other internal effect of any kind in the fuel which gives an appreciable positive temperature coefficient. Thus the experiments show that we have not overlooked any physical phenomenon which might give a positive temperature coefficient. Thus we have direct assurance that there is no intrinsic property of fast reactors which causes a positive temperature coefficient.

It is therefore generally agreed that the positive temperature coefficient observed in EBR-I was due to some features [fol. 3983] in the mechanical design of this reactor rather than to the high speed of the neutrons. Now the EBR-I was designed to make certain physical measurements, in particular to establish that breeding is possible. It was not intended for engineering tests, and was therefore not designed with the care, and did not have the mechanical rigidity, that one should demand of a power reactor.

The fuel elements in EBR-I are rods of U^{235} which are held at their top and bottom. When the reactor operates, the side of each fuel rod which is closer to the center of the reactor will become hotter than the side away from the center. This will make the inner side expand relative to the outer, and the fuel elements will bow. Since its top and bottom are fixed in vertical position, the middle of the fuel element will be pushed closer to the center of the reactor. This will lead to an increase of reactivity.

It is rather generally believed that this was the cause the positive temperature coefficient in EBR-I. One can estimate the amount of bowing that should occur at a given reactor power, and this is just about the right amount to explain the observed positive temperature coefficient. Unfortunately, it is not possible to make measurements of the position of fuel elements in the reactor while it is in operation, and therefore, we have no positive proof that bowing of the estimated amount actually took place in the reactor.

To find out whether bowing was responsible a program is at present under way to rebuild the EBR-I with a different mechanical design, as explained in more detail in the

testimony of Dr. Hilberry and Mr. Davis. The fuel elements will be made more rigid and will be held rigidly in place so that bowing will be greatly reduced. This program is being carried out at Arco, Idaho, by personnel of the Argonne National Laboratory. APDA and PRDC are vitally interested in the program and are helping to the best of their [fol. 3984] abilities.

In the design of the PRDC reactor, for example, the engineers have been aware for some time that inward bowing of the fuel elements must be avoided, and several alternative methods are being examined. The testimony of Mr. McCarthy will describe these designs more in detail. The intention is to assure either that no bowing occurs at all or that bowing should push the fuel elements farther apart in the core rather than closer together, and if this can be achieved, the reactivity will decrease rather than increase due to bowing.

The outcome of the test of the new EBR-I design will greatly influence the further design of fast power reactors, including the PRDC reactor. If it is found that the positive temperature coefficient has been removed as I am confident will be the case, we shall feel justified in going ahead on the basis of present design criteria; if it is not, we shall make further changes in design and further experiments to insure a negative temperature coefficient. The EBR-I test is scheduled to take place in the summer of 1957.

If bowing can be made to contribute a negative temperature coefficient, or if it can be eliminated, the total prompt temperature coefficient of the PRDC reactor will be negative, because of the thermal expansion of the fuel elements. With a negative prompt temperature coefficient, an accident of the EBR-I type cannot occur, the reactor will shut itself down when heated even if the heating occurs rapidly, and the reactor will then be safe.

The EBR-I experiments also revealed another type of instability, a resonance. When the reactor was operated at [fol. 3985] its normal power and the flow of sodium was reduced, a point was reached where the reactor power would begin to oscillate with a period of about fifteen seconds, without any external cause. These oscillations were investigated in considerable detail by means of a re-

actor oscillator, a device which I shall describe in more detail later in this testimony. The resonance is somewhat but not too closely related to the positive temperature coefficient. The resonance does not constitute a direct hazard but it would limit the power at which the reactor could be operated.

I have every reasonable expectation that the projected work on EBR-I will isolate the causes of instability, both with respect to temperature coefficient and resonance, and there is no reason to expect that any real difficulty will be encountered in designing a fast stable reactor with negative temperature coefficient of adequate magnitude and sign. I further expect that the experimental program will show the design of the PRDC reactor to be stable; at the least, I am confident that it will indicate design changes which can be made to accomplish stability.

(7) *Meltdown in the Presence of Sodium*

In normal operation all known reactors are extremely stable. Even the EBR-I which had a positive prompt temperature coefficient operated with great stability and reliability for four years. Normal operation will, therefore, not lead to meltdown with its possible consequences.

Meltdown is conceivable when a radical change has been made in the composition of the reactor. One major change which occurs regularly is the reloading of the reactor with new fuel elements. Investigations have made whether and in which way meltdown could occur in the PRDC reactor after reloading.

[fol. 3986] Of course, reloading is conducted in such a way that meltdown will actually not occur. The new fuel elements will contain just as much U^{235} as the old fuel elements did when they were fresh. As a precaution, care is taken that the new fuel elements are not inserted in the center of the reactor where they would contribute most to the reactivity but only in the outer parts of the core where the reactivity contribution is much smaller. The used-up central fuel elements will in turn be replaced by partly-used fuel elements which were previously located in the outer parts of the reactor core. This procedure will minimize any possible excess reactivity introduced by reloading.

The main concern then would be that perhaps one fuel element might slip in which contains U^{235} of a higher enrichment than is required for the reactor. It is not clear how this could come about, but to make doubly sure, APDA is at present considering testing procedures to which each fuel element pin would be subjected before insertion into a sub-assembly. This testing would be directed toward insurance that each fuel pin has exactly the U^{235} enrichment required.

Let us assume that in spite of these precautions, a fuel sub-assembly is inserted which is too highly enriched and therefore gives a larger contribution to reactivity than required. If this were to happen, it would be immediately discovered even while the reactor is being reloaded, because the instruments would indicate a rise to a higher neutron level. The instruments which are used in the shut-down condition during a reloading are sensitive enough to detect a reactivity which exceeds the required one by a fraction of a dollar. If such extra reactivity is discovered, the reloading will be immediately interrupted, some of the freshly loaded fuel element sub-assemblies taken out and replaced by others until the instruments indicate the correct [fol. 3987] reactivity.

Let us assume, however, that the operators responsible for the reloading (who of course will be particularly competent) fail to discover the extra reactivity. Then after the reloading process is completed the safety rods will be withdrawn and thereby the reactivity allowed to approach unity. As I have pointed out before, this will be done very slowly, at a rate not exceeding 1¢ per second, and the instruments will be operating all the time. If the neutron detectors do not work properly, an interlock will prevent the withdrawal of the safety rods. Assume now that the reactor has been loaded with too much fuel, that the operators have failed to notice this and that the safety rods are withdrawn. Then as soon as the reactor period becomes shorter than the setting of the period trip, the scram will operate and the reactor will be shut down. The same would happen if the power exceeded the operating power. Therefore, no meltdown will result even if the wrong type of fuel

element has slipped through the fuel element testing and even if the operators have failed to notice this.

An excess of power can only result if, in addition to these two unlikely events, there is a complete failure of the safety mechanism, if for instance the safety rods which were just withdrawn cannot fall back into the reactor. It is quite inconceivable to me just how this could happen. If it were to happen, and if in addition the movement of the safety rods out of the reactor could not be stopped—another most unlikely assumption—then the reactor might overheat and melt down.

These supposed conditions of a reactor meltdown, and other even more unlikely chains of events, would be quite similar to the conditions which were purposely created for experimental purposes when the EBR-I meltdown occurred. The postulated conditions would be somewhat worse than [fol. 3988] those under which the EBR-I accident occurred, however, because it is postulated that none of the safety mechanisms would work.

Let us, therefore, have a closer look into the meltdown incident of the EBR-I. The Argonne National Laboratory, as Dr. Hilberry has explained in his testimony, has studied in great detail the conditions of the core of EBR-I after its melting, and I am familiar with these studies; in fact, I have also examined the EBR-I core after meltdown. They have found that uranium was expelled from the center of the core. The density of the core before the incident was about 10.5 grams per cubic centimeter; after the incident the density at the center of the core was reduced to about four grams per cubic centimeter, and this remaining material was very porous. Apparently more than half of the uranium which was originally at the center of the core had been pushed out by the melting to a position near the edge of the core. Indeed, both on the sides of the reactor core and near its lower edge, one finds material which apparently was pushed into these positions from somewhere else, in addition to the material which was in these positions from the beginning and which shows no signs of melting. Below the center of the core there is a region in which the density was increased to 14 or 15 grams per cubic centimeter by addition of extra material. Thus

there is ample evidence that material from the center of the core was pushed toward the outside.

Now it is well known that the contribution of U^{235} to the reactivity is greatest when the U^{235} is near the center of the assembly. Material near the edge of the core contributes far less to the reactivity, and material pushed into the blanket would contribute less still. Therefore, the meltdown incident of EBR-I, far from assembling the material into one big mass of uranium, disassembled it and thereby reduced the reactivity.

[fol. 3989] While there is no positive evidence on the mechanism of this disassembly, it is reasonable to speculate that it might have happened like this. The molten uranium came in contact with liquid sodium, after eating its way through the steel cladding of the fuel elements. The boiling point of sodium is below the melting point of uranium; therefore the sodium immediately started to boil. Because the processes were rapid, the boiling sodium did not find an outlet along the normal coolant channels. Instead its pressure pushed the uranium away from the center of the core into the outer parts of the reactor.

Whether this mechanism is the correct explanation can only be determined by further examination of the EBR-I core, and by further theoretical work. However, it seems clear already that there was a rather strong force propelling the uranium outward. If the accident had been more severe, this force would have been still stronger and would have reduced the reactivity of the reactor even more.

It is not known whether the movement of U^{235} in fact shut down the EBR-I in its incident. The operator of the EBR-I hit the scram button when he noticed the fast power rise, and the automatic power scram was also functioning properly. It is therefore possible that the EBR-I was shut down by these scram mechanisms rather than by the expulsion of uranium from the center of the core. However, had all the scram mechanisms failed, it is clear in my opinion that the movement of fissionable material away from the center would itself have shut down the reactor.

Therefore, it appears that the melting of uranium in the presence of sodium which can vaporize does not lead to an

assembly of a supercritical mass but is instead a powerful mechanism for the shutdown of the reactor. At the same time, the pressures generated (presumably in the sodium [fol. 3990] vapor) are not likely to be enormously great. One evidence for this is the fact that gravity had time to operate in the EBR-I incident and assemble more uranium near the bottom than near the top of the reactor. Further, the forces were far too weak to burst the reactor vessel. Indeed, in the EBR-I incident, even the rather weak blanket was left intact.

Further careful analysis will be needed to establish all these points more reliably. However, even now it seems very likely that a meltdown in the presence of sodium will not bring the reactor above prompt critical but will provide an effective automatic shut-down mechanism.

[fol. 3991] (8) *Meltdown After Loss of Sodium*

Meltdown therefore can lead to serious trouble only if it occurs after the sodium from the reactor has been lost first. This is an even more unlikely eventuality than the startup accident which I discussed in the last section. Indeed, every precaution has been taken in the PRDC reactor design against the possibility of loss of sodium. Even if the pumps fail and if the power fails, the sodium will still remain in the system. As a matter of engineering, it is certainly possible so to design a reactor vessel and cooling system that the presence of sodium in the reactor will be guaranteed at all times, and I believe that the PRDC design as described in the License Application verbally does this. I believe that the sodium system of the PRDC reactor has been designed with greater care than that of any similar reactor, and that we can really be sure that a sudden loss of sodium will never occur.

Even if there should be a compound leak in the system, the sodium flows into a sump tank, and a sump pump takes it back into the reactor vessel tank. Thus, it has to be postulated that simultaneous with a compound leak in the system, there is a failure of the sump pump.

In this most unlikely contingency, the further course of events depends on the size of the leak. With any credible

leak, it will take many hours before the large sodium reserve tank is emptied of its 13,000 gallons of sodium. During these hours, the reactor can be unloaded beginning with the central fuel elements which contribute most to the reactivity. Even if this unloading cannot be completed before the complete loss of sodium, the remainder of the fuel in the periphery of the reactor is likely to be too dispersed to lead to a critical mass even if it melted down under the most unfavorable conditions.

[fol. 3992] If there were a loss of sodium through a leak of enormous proportions which persisted in spite of all the precautions taken such as double containment and the ability to recirculate, the sodium might run out of the large reserve tank in a few minutes. This would still give time for some precautionary measures, but I will consider the case when such measures are not taken, except that of course the safety rods are inserted and the reactor shut down immediately after the loss of sodium begins.

The reactor is then left after a few minutes without sodium and without power. However, the fission products accumulated from the prior operation of the reactor will continue to develop heat by radioactive decay. At a time of one second after shutdown, the fission product heat is about 6.5 per cent of the reactor power before shutdown. It then decreases as the 1/5 power of the time. Five minutes after shutdown, it amounts to about 2 per cent of the preshutdown power of the reactor.

In the absence of sodium, there is no way to dissipate this power. The reactor core will, therefore, heat up and melt, beginning perhaps half a minute after the sodium has been lost. The fuel at the center of the reactor will melt first, and then the melting will spread to the outer parts of the core in a time of another minute or so.

The details of the melting process are complicated and are only partially known at present. At the outset, therefore, it seemed desirable to try to avoid detailed consideration of the melting. To this end, two hypothetical situations were considered, both of them far worse than any credible situation. If these hypothetical situations had led to calculated accidents of moderate size which could have been safely contained in the reactor building, we would not have

needed to investigate in detail the probable course of a meltdown in the absence of sodium. Unfortunately, both [fol. 3993] calculations led to substantial release of nuclear energy; detailed investigation of the meltdown conditions has, therefore, become necessary, and is being undertaken both theoretically and experimentally by APDA and NDA.

The first study of an incredible maximum accident was made by NDA at the request of APDA. They assumed that after the loss of sodium, the sodium suddenly rushed in again, that it did so with the same speed it has in normal operation, and that in addition the sodium was able to move the (much heavier) molten uranium at the same great speed (30 feet per second). It is clear that these assumptions are little short of fantastic, and could not be realized under any conditions, not even if we purposely tried to do so. The energy release found by NDA was equivalent to 10,000 lbs. of TNT.

The second calculation of an incredible accident was done by Dr. Tait, a member of the British Atomic Research Establishment at Harwell, and myself. We did not assume that the sodium returned to the reactor. However, we assumed that all the uranium in the reactor melts without changing its position and then collapses under its own gravity. Although slightly more realistic than those of NDA, these assumptions clearly are still in the realm of fantasy. With these assumptions, I have calculated that a meltdown accident of the PRDC reactor would release an energy equivalent to about 1,000 lbs. of TNT. A more accurate calculation is still under way.

This figure I consider to be a gross overestimate. For instance, Dr. Tait and I assumed that the uranium does not fill the voids left by the loss of sodium, and this assumption, certainly incorrect, tends to overestimate the energy release, probably by a factor between 2 and 4. We assumed that all the uranium melts at the same time and then collapses all together; actually, the center of the reactor core will melt first and may flow away even before the outer parts of the core melt. Further, the uranium will trickle [fol. 3994] down rather than fall freely under gravity. All these and other considerations will tend to lower the energy

release very much. How much can only be determined by detailed investigation.

The original calculation by Tait and myself yielded an energy release of 350 lbs. of TNT rather than of the 1,000 lbs. which I now obtain. The difference between these two figures is mainly due to two causes. In the first place, the smaller figure referred to the British fast reactor which is being constructed at Dounreay, Scotland. The PRDC reactor has about twice as much uranium as the British reactor, and this increases the energy release in the postulated accident by a factor somewhat greater than the ratio of the masses.

Secondly, Dr. Tait and I assumed that no safety rods would be inserted into the reactor after the loss of sodium. Then the reactivity before collapse will be negative only because the sodium has been lost; this gives a negative reactivity of about $2. It is a sounder procedure to insert the safety rods as soon as the loss of sodium becomes apparent. If this is done, the reactivity is $10 negative, and it is very likely that no reasonable flow of uranium will bring the reactor back to critical again. I will discuss this further below, in connection with more realistic calculations of the accident which are at present being done at NDA. However, if we make the arbitrary and unrealistic assumptions of Tait and myself, namely that the accident nevertheless will happen in any case, and that the core collapses under gravity, we find the somewhat surprising result that the accident gets worse if the negative reactivity before collapse is greater. This is because a greater amount of collapse is required to compensate a great negative reactivity, and if a greater amount of collapse is assumed, a higher part of the core may be assumed to be included in the collapse and so to fall from a greater height and there-
[fol. 3995] fore to acquire a greater speed due to gravity. This means that at the time when criticality is reached again, the reactivity increases at a faster rate if the safety rods have been inserted than without this insertion, and this in turn causes the energy release in the accident to increase.

An interesting result of the calculations of Tait and myself is that the energy release does not depend strongly

on the speed of the neutrons in the reactor. This speed is most conveniently measured by the neutron lifetime, i.e., the average time which a neutron takes, from its birth in one fission to its absorption in the next fission. The energy release is inversely proportional to about the fourth root of the lifetime. Since the lifetime in fast reactors is about 1/100 of that in thermal ones, the energy release in the Bethe-Tait type accident is only about three times what it would be in a thermal reactor. Thus, the influence of the "fast" character of the reactor is only moderate, even though prompt critical is exceeded in this type of accident.

It is not known whether an explosion of 1,000 lbs. of TNT equivalent can be contained in the many containers provided in the proposed PRDC reactor. The explosion would certainly burst the reactor vessel. Much of its violence would be dissipated in compressing the blanket and deforming the shield. Presumably some shock wave will still be transmitted into the air of the reactor building. Whether or not this shock wave can be contained in the steel shell of the reactor building is not known at present. If the answer is negative, it is again not known how much smaller the energy release has to be before it can be contained.

I understand that the Atomic Energy Commission is sponsoring an investigation of the whole containment problem. This investigation, which may include model experi- [fol. 3996] ments, may give us a much better idea on the limitations of containment. In principle of course, any explosion can be contained in a building of sufficient strength.

We should remember, however, that the model of Tait and myself is only an extreme assumption which has no relation to reality. The relatively large amount of explosive energy which was obtained in these calculations only indicates the necessity for a more detailed investigation of the actual sequence of events in the meltdown in the absence of sodium.

Such detailed investigations are now under way. As Dr. Hilberry has stated in his testimony, the Argonne National Laboratory is planning to construct a meltdown facility for the investigation of the actual process in the

melting of uranium fuel elements, and of the subsequent flow of the molten material down the reactor. ANL in collaboration with the Los Alamos Scientific Laboratory plans to take the results of ANL meltdown studies as the basis of calculations of the energy which might be released if a critical mass should be reassembled by the meltdown. The special knowledge of the Los Alamos Scientific Laboratory on nuclear explosions and on the behavior of matter at high temperatures will be very useful for these calculations.

APDA has also initiated similar studies of its own. Nuclear Metals, Inc., at Cambridge, Massachusetts, under the direction of Dr. A. R. Kaufmann, is setting up experiments to study the melting and flow of uranium, using similar geometric configurations to those which will exist in the reactor, but using natural uranium rather than U^{235}, and electric rather than nuclear heat. It is hoped that these studies will give detailed information on the melting of the zirconium cladding which is around the uranium fuel elements in the PRDC reactor, on the flow of molten uranium, and on the possible refreezing of this uranium.

[fol. 3997] At the same time NDA at the request of APDA is making theoretical studies of the same problem. One of their problems is whether the molten uranium will freeze again as it flows down the reactor. In principle, such refreezing is possible because the U^{235} in the lower part of the core contains less fission products than that in the center and, therefore, will not yet be up to the melting point when the center melts and begins to flow down. In the lower blanket section, below the reactor core, there is depleted uranium in which the fission product heat is negligible, so that the temperature is very low. The present tentative conclusion from the NDA calculations is that the molten uranium which flows from the center of the core will not freeze again in the lower section of the core but may at least partly refreeze when it comes into the lower blanket. These calculations are incomplete, and even after their completion we shall await confirmation of the theoretical results by the experiments at Nuclear Metals and Argonne National Laboratory.

The question whether the molten uranium freezes again while flowing through the bottom of the reactor is of prime importance for the further course of events. If there is no refreezing at all, then in the proposed PRDC reactor the material will leave the reactor region and drop down into the special meltdown compartment which is provided at the bottom of the reactor. In this meltdown compartment, the molten uranium is permitted to distribute itself over a very wide area, 8 feet in diameter, which will make the layer of uranium in this compartment very thin even if all the fuel should drop down into it. Such a thin layer will not be critical even if it is surrounded by good neutron reflectors. Detailed calculations will be made to insure that the full amount of uranium in the meltdown compartment will remain far below critical, taking into account reflection of the neutrons from the materials which may actually surround the fuel when it is in the meltdown compartment. For instance, it will be taken into account that the blanket [fol. 3998] may drop into the meltdown compartment in the course of events. Special care will also be taken to design the meltdown compartment in such a way that the fuel is certain to distribute itself uniformly over the area provided. If necessary, knobs or dividing walls containing a nuclear poison such as boron-10 will be provided in the meltdown compartment in order further to reduce the reactivity of the fuel when it is in that compartment.

If there is no refreezing, the flow of fuel through the reactor will be fast enough so that all of the fuel flows out very shortly after it melts. For instance, the fuel from the center of the reactor core will have flowed out long before the fuel near the edges begins to melt. In this way accumulation of fuel in any one section of the reactor, whether in the core or in the lower blanket, is minimized. I am confident that under these conditions the reactor will not get up to critical again if, by insertion of the safety rods, the reactivity starts out at $10 negative. NDA has started a more accurate calculation of the multiplication factor of the reactor as a function of time after melting begins. Once the flow of molten uranium is known, one can calculate the distribution of fuel at any instant of

time and can then calculate the value of the multiplication factor k for this distribution.

On the other hand, if uranium freezes again, for instance on its way through the lower blanket, the channels for its flow become clogged and further molten uranium will then accumulate on top of the clogged channels and mainly in the bottom of the reactor core. If this were to happen, conditions somewhat similar to those postulated in the Bethe-Tait accident calculations might arise. However, the rates of assembly of the fuel would undoubtedy be much slower than assumed in the Bethe-Tait calculation, first because not all the uranium would drop down at once and secondly because it would merely trickle down rather than [fol. 3999] fall freely by gravity. With the much smaller rate of assembly of the fuel would undoubtedly be much smaller and would appear to be containable in the many containers surrounding the reactor and finally in the reactor building.

However important it is to investigate the course of a possible meltdown accident with the present PRDC design, it is far more important that these same investigations may point the way to improvements in the design. It is very likely that no serious freezing of the uranium can occur in the lower part of the core but only in the lower blanket. If this is confirmed, and if the NDA calculations and the experiments at Nuclear Metals and ANL indicate a reasonable possibility that the uranium will refreeze in the lower blanket, APDA will seriously consider eliminating the lower blanket from the reactor. This will entail some moderate loss of breeding and some moderate increase of critical mass. It will, therefore, reduce the economic value of the reactor, though not too seriously. However, under the conditions outlined, the sacrifice of the lower blanket would eliminate entirely the nuclear accident after meltdown, even after the loss of sodium.

The possible removal of the lower blanket is only one example of positive action which can be taken in changing the reactor design depending on the results of the current research program. Other design changes may be made if called for. At present, we do not have sufficiently realistic information on the course of meltdown accidents, but only

educated guesses. However, a vigorous research program is under way to fill the gaps of our knowledge, and the design of the PRDC reactor is sufficiently flexible so that it can profit from the results of this program. I have reasonable hopes that this combination of research and design change will lead to a reactor which cannot have *any* nuclear accident after meltdown. I am confident that the [fol. 4000] reactor can be designed in such a way that no credible meltdown situation can result in an accident of sufficient energy to breach the containment building.

(9) *Pre-Operational Testing*

To the greatest extent possible, advance experiments and engineering evaluation are performed to assure the safety of any reactor, and this will, of course, be the case with the PRDC reactor. However, a reactor should be subjected to a rigid pre-operational testing which can be carried out safely at every step. Pre-operational testing is carried out following completion of the construction of a reactor. This procedure provides a method for further check on experimental and theoretical results, and to be most effective must be carried out on the reactor itself. Consequently, such tests cannot be conducted until a reactor is completely constructed and ready for the introduction of nuclear fuel.

Before the PRDC reactor is assembled in Michigan, its critical mass and many other nuclear properties will be measured in a critical assembly in the Arco, Idaho, facility of the Argonne National Laboratory. Because there are some necessary differences between the structure of a critical assembly and of an engineered reactor, it is expected that the critical mass of the final PRDC reactor may differ from that measured in the critical assembly by up to 5 per cent, either way. The reactivity value of the control and safety rods, and of fuel elements in various positions in the reactor, will also be measured in the Arco critical assembly. Moreover, it will be possible to measure the subcritical multiplication of a neutron source, with various percentages of a critical mass loaded in the reactor, and with various neutron detectors.

When the reactor is ready for assembly in Michigan, the fissionable material will be put in place piece by piece, in the presence of a strong neutron source. The details of the [fol. 4001] start-up procedure are described by Mr. McCarthy in his testimony. The central fuel elements are loaded first, and then the loading proceeds spirally outwards so that, as criticality is approached, the reactivity value of each of the last fuel elements is much less than a dollar (about 40 cents).

The subcritical multiplication of the neutron source by the fissionable material will be measured at each stage of loading with several neutron detectors of different characteristics. From these measurements, the critical mass can be predicted in various different ways. The most common method is to plot the reciprocal of the multiplication, 1/M, as a function of the mass of fuel. As the critical mass is approached, these plots become straight lines which point to the critical mass (at infinite multiplication M). Since several different neutron detectors are used, several different straight lines are obtained which should all extrapolate to the critical mass and thus provide a check on each other. This method, which has been used on many reactors in the past, permits a very accurate prediction of the critical mass.

Another method which is even more accurate, especially at early stages of the assembly, makes use of the previous experience with the Arco critical assembly. If the same neutron source and neutron detector are used, then the same multiplication will be measured in the PRDC reactor and in the Arco critical assembly, when the same fraction of the critical mass has been assembled. Thus, it will be possible to determine the fraction of critical mass assembled at every step.

The last steps before criticality is reached will be taken with especial care. Multiplication will be measured after the addition of each new subassembly with the safety and control rods in, and after every three subassemblies also with the rods out. Close to criticality, the procedure of [fol. 4002] plotting the reciprocal of the multiplication factor against mass becomes especially accurate, and it will

be easy to predict exactly which subassembly will make the reactor critical.

The approach of a reactor to critical is no longer a hazardous procedure, but one which has been carried out dozens of times and has become routine. Moreover, the start-up of the PRDC reactor will be carried out by especially competent personnel who have been trained previously in this operation. Especially when criticality is near, the most competent members of the APDA staff and of its consultants, as well as experienced AEC representatives, will be present. I, therefore, believe that there is no hazard involved in the assembly of a critical mass in a populated area.

When the critical mass is finally reached, the control rods will be pulled out slowly, and the neutrons will be allowed to multiply until some low power level is attained, perhaps a few watts. At this low power level, the control rods will be calibrated, the safety rods tested, and the neutron responses to changes of reactivity measured.

At such low power level, the operation of the reactor can be completely predicted from theory because the fuel will not be heated, and there can be no effects from the bowing of fuel elements or from other mechanical features of the reactor. The behavior of the reactor then depends only on the properties of fission neutrons, in particular of the delayed neutrons, and is the same for fast and for thermal reactors, as I have pointed out before. The test at this low power level is, therefore, completely predictable and completely safe. Furthermore, the fuel is not radioactive at this time, because the reactor has not operated at high power levels.

If the reactor is found to behave satisfactorily at a power of a few watts, the power will then be raised to about 300 kilowatts of heat, which is only 0.1 per cent of the [fol. 4003] power at which the reactor is supposed to be normally operated. The coolant will be permitted to flow at its regular rate so that the temperature of the fuel will rise by only about 1/1000 of the amount it would rise at full power; i.e., a fraction of a degree. Such slight temperature changes cannot change the reactivity measurably, and in particular cannot lead to noticeable bowing. So the be-

havior should still be the same as at a power of a few watts, and this will be checked by experiments. The same will then be done at 1 per cent of the operational power level, where the same considerations still hold.

Then the power will be raised in slow steps. The steps presently proposed are 5, 12.5, 25, 50 and 100 per cent of the normal operating power, but this schedule is only tentative. At every stage a full set of experiments will be made to check the reactor behavior. The power will not be raised to the next level before a completely satisfactory result is obtained at the lower power level. As the power is raised, the fuel will expand and may possibly bow, and we shall thereby have a chance to examine the effect of fuel temperature on the reactivity and make sure that no positive temperature coefficient exists.

The chief instrument for studying the reactor behavior will be the reactor oscillator. This is a special control rod which can be moved rapidly in and out of the reactor. This control rod is made in the form of a cylinder, one half containing graphite, a good neutron moderator, and the other containing boron-10, a strong neutron absorber, in the form of boron carbide. The rod can be rotated at any frequency from 0.01 to 25 cycles per second, and if it is so rotated, the reactivity will change regularly and periodically by a certain small amount. This amount can be selected by putting a suitable amount of boron-10 into the rod; it is planned to restrict the reactivity change to [fol. 4004] 6 cents. Then the rotation of this oscillator rod from the position where the boron is "out" of the reactor, to the "in" position, will cause such a small change of reactivity that no danger could result even if the rod stayed in the out position. Its 6 cents could easily be compensated many times over by any safety or control rod or by a rise of only about 30° F in the average reactor temperature.

When the oscillator is used to change the reactivity of the reactor, the reactor power will also oscillate with the same frequency. One can then measure the amplification, i.e., the ratio of the amplitude of the power oscillation to that of the reactivity oscillation. One can also measure whether or not the power is in phase with the reactivity, i.e., whether the maximum of power is reached at the same

time as the maximum reactivity, or if this is not the case, one can measure the difference in phase between the two oscillations. These two data, the phase lag and the amplification, will be measured with the oscillator oscillating at different frequencies, and all this information together will give a picture of the reactor characteristics.

I have developed the theory of these measurements in some detail and have published the results in a report, APDA-117, which is included as an exhibit to the PRDC License Application, as amended, and is incorporated by reference in this testimony. The theory shows that if the reactor has an instability (for instance, a resonance) at some high power, let us say at 300 megawatts of heat, one can predict this instability very well from experiments at much lower power, let us say at 50 to 100 megawatts. This is precisely the purpose of these experiments, namely to get advance warning of instabilities long before these instabilities actually occur, and this feature greatly contributes to the safety of oscillator experiments.

[fol. 4005] To make them still safer, we shall not simply increase the power by steps while keeping the coolant flow constant, but we shall first do experiments at lower power with reduced coolant flow. What we really want to study is the behavior of the reactor at different fuel temperatures because it is the temperature of the fuel which determines its expansion, its bowing, and its Doppler effect. Therefore, we should get essentially the same result if we operate at one-quarter of full power and one-quarter of full coolant flow as if we operated at full power and full coolant flow.

Staying at relatively low power and reduced coolant flow has several advantages. First of all, the total accumulated radioactivity will be kept low, so that if against all expectations there should be an accident, not many fission products would be released. Secondly, the slower the coolant flows, the slower also will be the responses of the reactor. We can then operate the oscillator at low frequency which is easier mechanically and again increases the safety.

To measure in particular the prompt positive temperature coefficient, we shall reduce the flow of coolant to a very small amount, possibly shutting it off completely, and we shall use very low power, perhaps 1 per cent of normal operating power. If then the power oscillation is in phase

with the reactivity oscillation, this indicates a positive prompt temperature coefficient; if it has the opposite phase, then the temperature coefficient is negative. If in this experiment, contrary to what I believe will be the fact, the temperature coefficient should turn out to be positive, we shall take the reactor apart and redesign it.

This method for measuring the prompt temperature coefficient is quite different from the transient one used in the EBR-I. Even if the prompt temperature coefficient is positive, our method will be completely safe. This is be-
[fol. 4006] cause on the average the reactor fuel is not heated up. The power is alternately higher and lower than it was without the oscillator working, so that on the average it is not changed and the average fuel temperature and the average reactivity likewise remain unchanged. If there were any small change of average reactivity, this could be compensated by re-setting the main control rod. If there were any increase of average temperature, this could only be very slow and would then be communicated to the whole reactor, and, as I have mentioned before, the *over-all* temperature coefficient, corresponding to heating of the whole reactor, was negative even in EBR-I, and, therefore, this procedure is safe.

To measure the prompt temperature coefficient, we must change the temperature of the fuel alone, and we must do this very rapidly. This rapid change is provided in our method by rotating the reactor oscillator with high frequency. It is quite unnecessary to oscillate the reactivity with a large amplitude; a few cents is sufficient if we have sensitive instruments to observe the power oscillation. Even at the moment when the oscillator is completely "out," the excess reactivity will only be a few cents (which causes no hazard), and a moment later it is minus the same number of cents.

In the EBR-I transient experiment, on the other hand, the way by which the fuel temperature could be changed rapidly was to provide a large excess reactivity, in the end about 75 cents. This is relatively dangerous; the fuel heated rapidly without heating the rest of the reactor structure, and the reactor went out of control. We have no intention of using this hazardous procedure. By providing rapid

change without appreciable excess reactivity, our procedure will be safe and will still give the same information.

If, contrary to my expectations, our measurements do show a positive prompt temperature coefficient, we shall, of course, try to find its cause, which is likely to be some [fol. 4007] feature in the mechanical design of the fuel element. We shall then redesign the relevant part of the reactor core, put it together again, and repeat the tests. The reactor structure is sufficiently flexible to permit redesign without rebuilding the reactor vessel, the shield and other major parts.

A positive prompt temperature coefficient is not the only possible reactor instability; there is also the possibility of a resonance. As I have mentioned before, the EBR-I had such a resonance, at a frequency of about 0.4 cycles per second at full power and reduced coolant flow. Such a resonance is not in itself dangerous, but it makes it impossible to operate the reactor above the critical power at which it occurs. There is good hope that the resonance of EBR-I, together with the positive temperature coefficient, can be eliminated by a better mechanical design and that the mechanical design of the PRDC reactor has in fact accomplished this. The reactor oscillator is particularly suitable for finding a resonance, and if one exists, however, just as in the case of the positive temperature coefficient, it will be possible to predict the existence of a resonance at a much lower power than that at which the resonance occurs.

Summarizing, it is my opinion that safety tests with the help of a reactor oscillator can be carried out without danger to public safety and that the tests will give all the information required to insure safe operation of the reactor subsequently.

(10) *Safety Consciousness of PRDC*

As a consultant, I am not directly a member of the APDA staff, and thus I have an opportunity to observe their operation from the outside, though very closely. I am also in a position to make comparisons with other reactor laboratories with which I have been or am presently associated.

[fol. 4008] I am happy to be able to state that, in my experience, PRDC, and APDA, as well as the Dow-Detroit Edison group, have always been fully conscious of the requirements of safety. Because of their concern about safety, APDA arranged a meeting on the safety of fast reactors in Detroit in the Fall of 1954. This was the first meeting on this subject of such broad scope. Only one similar meeting had been held previously, under the auspices of the AEC, in New York City about 1949, but that meeting was much smaller and less comprehensive.

The safety meeting at Detroit was attended by many scientists from AEC and industrial laboratories and was considered very much worthwhile by all participants. The full record of the meeting has been published. It was the consensus of the participants in the meeting that the safety of fast reactors was not an extremely difficult problem and that most of the outstanding problems were on the way to being solved.

Further evidence of the concern of APDA for safety is shown by the fact that in my consultant's contract with this company, reactor safety and reactor design were specified as the two major problems with which I should be concerned.

Early in 1955, APDA urged that oscillator experiments be done on EBR-I, and these led to the discovery of a resonance in that reactor. Scientists from APDA and NDA, at the request of APDA, made major contributions to the early analysis of the resonance experiments. The fact that the resonance remained unexplained was the main reason ANL undertook the further experiments which finally led to the often mentioned accident to EBR-I. Full understanding is the primary requirement for safety, and even the lessons from the EBR-I accident itself are likely to help us to insure that no accident will occur in the PRDC reactor.

[fol. 4009] APDA initiated calculations at NDA of possible reactor accidents, considering the worst possible circumstances. At the request and expense of APDA, NDA made the first reliable calculations of the Doppler effect in fast reactors, which were then followed by calculations of the British Project and by some of my own.

Early in 1956, APDA initiated designs of the PRDC reactor, which would either avoid bowing or make the

temperature coefficient due to bowing negative. APDA had long been aware of the problem of the positive temperature coefficient of EBR-I and of the meltdown problem, and was engaged in programs for their solution. Since last summer, these programs have been intensified. There is close coordination between APDA and Argonne National Laboratory, both in fast reactor design and in safety programs.

(11) *Summary*

By the application of theoretical physics to what we now know, it is my opinion that a fast breeder reactor of the general type proposed by PRDC can be constructed and operated in a populated community without undue risk to the public, and that it can be demonstrated, when such reactor has been built, that its operation is safe.

The information to be developed by the projected program of APDA, including pre-operational testing, and by the related programs of ANL and other agencies of the AEC, will in my opinion eliminate any uncertainties that may now exist with respect to operation of the proposed PRDC reactor. I believe that this information will be sufficient to enable PRDC to furnish such additional technical information as is required to complete its Application for License under Section 104 b of the Atomic Energy Act of 1954.

On the basis of what we already know as a result of experimentation and research, operating experience with reactors, and theoretical calculations, it is my further [fol. 4010] opinion that such additional information will in fact show, with very high probability, that a reactor constructed in accordance with the present PRDC design can be safely operated. Even if the planned investigations should not demonstrate safety on the basis of the present design, they will at least substantially eliminate areas of uncertainty and point the way to changes in particular features of the design so as to assure safety. The design of the PRDC reactor is sufficiently flexible to accommodate such changes.

[fol. 4012] In evidence January 8, 1957, Tr. 43

BEFORE THE ATOMIC ENERGY COMMISSION

Docket No. F-16

In The Matter of

POWER REACTOR DEVELOPMENT COMPANY

TESTIMONY OF NORMAN HILBERRY,
DEPUTY DIRECTOR, ARGONNE NATIONAL LABORATORY

Background and Qualifications

My name is Norman Hilberry. I am the Deputy Director of Argonne National Laboratory. Since July 1, 1956 I have been acting in this capacity as the Laboratory's chief executive officer.

I was born in Lakewood, Ohio, now a suburb of Cleveland, on March 11, 1899. I received my Bachelor's degree with majors in both physics and mathematics from Oberlin College in 1921, started graduate work in physics at the University of Chicago in the fall of 1921, and accepted a position as instructor in the Physics Department at New York University in the fall of 1925. I taught both undergraduate and graduate physics courses at New York University, first at Washington Square College from 1925 to 1928 and then at the University Heights campus as an instructor from 1928 to 1930 and as an Assistant Professor from 1930 until the summer of 1940, at which time I returned to the University of Chicago on sabbatical leave and completed my graduate work. I received the Ph. D. in physics from the University of Chicago in the spring of 1941. The summer of 1941 was spent as a member of a State Department-sponsored cosmic ray expedition to South America. After a month utilized in making high altitude cosmic ray measurements in the Andes of southern Peru, I was a member of a symposium on cosmic rays sponsored by the Brazilian Academy of Sciences in Rio

de Janiero, returning to New York University in the fall of 1941.

[fol. 4013] In December of 1941 I was asked by Dr Arthur H. Compton to serve as his assistant on a war project which was just then being organized. This project was known during the war as the Metallurgical Project and since has been renamed the Plutonium Project. I reported for full-time duty on January 1, 1942 and have served in the national atomic energy activities continuously since that time.

During the early part of 1942 I had an active role in organizing the Metallurgical Project, not only by assisting in establishing it as an administrative unit but also by establishing and staffing new scientific divisions to meet the swiftly broadening demands for the incorporation of additional scientific and technical disciplines. During this same period my responsibilities included arranging for the necessary developmental work on methods for the production of the extremely pure graphite necessary for nuclear reactor construction and for obtaining this graphite in quantities adequate to meet the project needs. My duties also involved an active part in the procurement of the necessary high purity uranium metal. I was one of a group of three who served as the first site selection board for an atomic energy facility, recommending the selection of the present Oak Ridge site in the spring of 1942. Shortly after our selection of a site had been made, the Manhattan District of the United States Army Engineer Corps was organized, and our recommendation was forwarded to them for action, resulting in the acquisition of the present Oak Ridge site. As a member of the group present in the West Stands laboratory at the University of Chicago when the [fol. 4014] first nuclear reactor went critical on December 2, 1942, it was my assignment to man one of the several manual safety control devices provided for "emergency shut-down."

During the calendar year 1942, the activities of the Metallurgical Project expanded rapidly. In addition to the Metallurgical Laboratory itself, additional project groups became necessary and these were established under separate contracts at numerous other locations, such as Iowa State

College at Ames, Iowa, the University of California at Berkeley, California, Battelle Memorial Institute at Columbus, Ohio, and Washington University at St. Louis, Missouri. It was necessary to provide some organizational mechanism to handle all matters of technical administration for these associated contracts and to assure that the scientific program of the project as a whole was effectively coordinated. For this purpose, a Metallurgical Project Office, independent of the Metallurgical Laboratory, was established, with Dr. Arthur H. Compton as Director, to serve as the central executive unit for the Project as a whole. From January 1, 1942 until May, 1943, this Project Office reported on matters of both program and administration to the Office of Scientific Research and Development, which was the governmental agency responsible during this period for the over-all atomic energy program. From May, 1943 until July, 1946 it reported to the Manhattan District, U. S. Army Engineer Corps, and it was discontinued July 1, 1946. First as assistant to Dr. Compton and later as Associate Project Director, I served as the executive officer for this Project Office.

In the spring of 1942, active steps were taken to design [fol. 4015] a reactor of large enough power to produce experimental quantities of plutonium and a chemical process plant adequate to separate this plutonium from the uranium fuel elements in which it was formed. These facilities were designed with the assistance of E. I. duPont de Nemours & Co., Inc., and constructed at the Oak Ridge site. They formed the key facilities of the Clinton Laboratories which were established, staffed, and operated during the war by the University of Chicago. Construction of these facilities proceeded during 1943, and the X-10 reactor went critical in November of that year. As the representative of the Metallurgical Project Office, I was present at Clinton Laboratories during the final stages of the construction and throughout the start-up of this reactor.

During this period also, construction was completed in the Argonne Forest section of the Palos Park Division of the Cook County Forest Preserve of facilities to house the first nuclear reactor. The reactor itself was disassembled

from its location in the West Stands and reassembled in the new laboratory facilities. It was here also that the world's first heavy water moderated reactor was built and put into operation in May of 1944. Although the Argonne Forest laboratory was administered as a separate unit, it was operated under the same prime contract as the Metallurgical Laboratory itself.

In January, 1943, active design was started on a full-scale plutonium production plant. The Metallurgical Project was responsible for all matters of basic scientific and technical design, while E. I. duPont de Nemours & Co., Inc., was responsible for all detailed engineering design for construction and eventual operation of the plant. As a matter of contractual obligation, the Metallurgical Project was required to approval all final drawings, specifications, [fol. 4016] and initial operating procedures for the Hanford plant from the point of view of operability as far as basic science and technology were concerned.

In July, 1944, I was appointed Associate Project Director of the Metallurgical Project and assigned to Hanford as the liaison between the duPont company and all of the Metallurgical Project laboratories, in particular the Metallurgical Laboratory itself and the Clinton Laboratories. This role called for an active part in the start-up of the Hanford reactors in the fall of 1944.

During 1945 and the first half of 1946, the responsibilities of the Associate Project Director included the planning for re-establishment of the wartime atomic energy projects on a permanent peacetime basis and for the establishment of certain new atomic energy installations, including Brookhaven National Laboratory and the reorganization of the Metallurgical Laboratory and the Argonne Forest Laboratory into the present Argonne National Laboratory.

With the final establishment of Argonne National Laboratory on July 1, 1946, I became Associate Director, and on December 1, 1950, I was appointed Deputy Director. As a result, throughout the past ten years I have been in active contact with all of the Laboratory's reactor activities. These have included the first Experimental Breeder Reactor, EBR-I; certain phases of the design of the Materials Testing Reactor; the design, construction, and

operation of the Laboratory's heavy water research reactor, CP-5; the conceptual design and basic engineering of the Mark I Submarine Thermal Reactor; the conceptual design of the Savannah River Production Reactors; the design, construction, operation, and experimental programs associated with the BORAX reactors; the design and [fol. 4017] construction of the Experimental Boiling Water Reactor; the design of the Experimental Breeder Reactor, EBR-II; the design of the Argonne Low Power Reactor, to serve as a package reactor for use as a power supply in remote locations; the design and construction of the Argonaut, a training and limited research type of reactor; and the conceptual design of the ARBOR reactor, to meet full-scale engineering development requirements.

Incidental to these major reactor projects, my duties have required continual contact with the Laboratory's Zero Power Reactor program, which has included the zero power version of the Submarine Thermal Reactor, ZPR-I; the zero power mock-up of the Savannah River reactor, ZPR-II; the zero power mock-up of the Experimental Breeder Reactor, ZPR-III; the fast exponential experiments on fast reactors, ZPR-IV; and the coupled fast-thermal zero power reactor, ZPR-V. These projects have spanned the ten-year period since Argonne National Laboratory was established and have provided essentially continuous contact with highly important and productive reactor development activities.

The Laboratory is now preparing for the start-up and operation of the Experimental Boiling Water Reactor and of the Borax-IV reactor. Criticality experiments are under way with both reactors, and full-scale operation is scheduled in the immediate future. Argonne is also currently engaged in preparing detailed plans for rebuilding and operating EBR-1, and for the design, construction, start-up, and operation of a new Experimental Breeder Reactor, EBR-II. The Laboratory has completed the initial design of this [fol. 4018] new reactor, and is presently directing the activities of the architect-engineer on producing the detailed engineering design. The Argonaut reactor for university training and reactor research is nearing completion, and start-up is scheduled for the immediate future. The ARBOR reactor has been approved, and an architect-engineer is

being selected preparatory to proceeding with final design and construction. As the Laboratory's acting chief executive officer, I am administratively responsible for the execution of this program.

In all of these many reactor projects, commencing with the construction of the first nuclear reactor under the West Stands at the University of Chicago, considerations of safety and site location have been matters of primary concern to me and to others charged with responsibility for these projects. With other senior laboratory officers, I have taken an active part in the discussions upon which the decisions were based as far as most of these reactor projects have been concerned, and I have, of course, shared in the decisions as to site and safety features for those for which the Laboratory has had responsibility for construction and operation.

General Program

I am generally acquainted with the design of the proposed Power Reactor Development Company (PRDC) reactor and with the material included in its Application for License, as amended. I have also read the direct testimony to be given in this proceeding by Messrs. Amorosi, McCarthy, [fol. 4019] Bethe and Davis. I agree that the most important areas in which additional technical information must be supplied with respect to fast breeder reactors of the general type proposed are those which concern stability, temperature coefficients and effects of any credible meltdown. My testimony will be largely directed toward a brief summary of the information presently available in these areas, and an outline of the research program which is being carried out by Argonne National Laboratory in conjunction with other Atomic Energy Commission laboratories, Atomic Power Development Associates, Inc. (APDA), and others. In my opinion this program will not only provide much of the technical information in these areas which is needed to complete the PRDC License Application, but it will provide confirmation of the assurance which I believe we already have that a fast breeder reactor of the general type proposed can be so designed and constructed that it can be operated in a

populated area without undue risk to the health and safety of the public. There is, of course, no possible public hazard involved in any event in the mere *construction* of such a reactor, prior to the introduction into it of nuclear fuel.

The fast reactor program of Argonne National Laboratory is even older than the Laboratory itself; since before its establishment as a permanent laboratory in July, 1946, ANL and its predecessor have been actively engaged with the problem of fast breeder reactors. One of the final acts of the Manhattan District was to approve the Laboratory's proposal for studies leading to the design and eventual construction of a fast breeder reactor. These studies started in 1945 and have been carried on continuously to the present [fol. 4020] time. First as Associate Director and subsequently as Deputy Director of the Argonne National Laboratory, I was continually advised of and informed upon the planning and execution of this program.

These studies led to the design, construction, and operation of the first Experimental Breeder Reactor, EBR-I, which was completed in 1951. This was the first nuclear reactor to produce significant quantities of electrical power, providing sufficient power for self-contained operation of the plant and associated laboratory facilities. Initial operation was carried out on the Mark I core from 1951 to 1954. Measurements on this first core proved that even in this design the amount of plutonium produced was at least equal to the quantity of uranium-235 burned. Additional experiments were carried on with a Mark II core until November 29, 1955, at which time this core was rendered inoperative as the result of a fast excursion experiment, which I shall discuss further below.

Arising out of the studies of EBR-I, the Laboratory has undertaken a critical survey of the kinetic behavior of fast reactors, with the objective of determining more precisely the safety characteristics inherent in this class of reactor designs. These investigations will include studies of possible positive temperature coefficients and of possible operating instabilities which could arise as a result of temperature feed-backs. In addition to these kinetic studies which it is proposed to carry out on the present EBR-I reactor, the Laboratory, in cooperation with the Los Alamos Scientific

Laboratory, is also examining the possibilities of hazards which might arise in this type of reactor due to a postulated sudden compacting of the core arising from meltdown or [fol. 4021] other imagined nuclear incident.

In the meantime, in connection with the planning for a second experimental breeder of considerably larger size, a zero power reactor or critical experimental facility (ZPR-III) has been designed and constructed to carry out the necessary nuclear studies required in the design of a fast breeder reactor. This facility was placed in operation in October, 1955, and is presently engaged in a program of fast reactor studies.

Concurrently, design and development work needed to establish a definitive design for the new experimental breeder, EBR-II, has been carried out. As of the present time the first phase of the design work has been completed and an architect-engineer has been chosen to assist the Laboratory in producing the complete engineering design, including the necessary construction drawings.

In connection with design of the new Experimental Breeder, EBR-II, two ancillary programs are of significance. The one deals with the irradiation studies which the Laboratory is carrying on in connection with the determination of the irradiation stability of various fuel elements and fuel components and in particular, prototype designs for the EBR-II reactor and for the PRDC reactor. The other program deals with the continuing engineering studies associated with the technology of the use of sodium as a reactor coolant. This involves the engineering test of full-scale components, pumps, valves, seals, etc., using liquid sodium under the temperature conditions planned for the EBR-II reactor.

Since each of the above activities in the program of Argonne National Laboratory has a bearing on considerations of the inherent safety of the PRDC reactor, each will be presented in some detail.

[fol. 4022] *Experimental Breeder Reactor—EBR-I*

The Experimental Breeder Reactor, EBR-I, was designed initially to provide a facility to study the physics of fast

reactors, particularly the breeding characteristics of such a reactor and secondly, to study the technology involved in the use of liquid metals as coolants for fast reactors. At the time these investigations were first started, fissionable material was scarce and urgently needed for military objectives. As a result, the reactor was designed for minimum critical size. This requirement resulted in an active core of very small size. The core volume was a hexagonal section essentially seven and one-half inches between flats and seven and one-half inches long. Since a major problem in fast reactor design is that of neutron leakage, it is clear that minor deviations in geometry in such a small core produce relatively much larger changes than would be produced by the same geometric deviation in a much larger core. The use of the small core also tends to make the heat transfer and temperature gradient problems more serious. Both of these problems would have dictated the use of a diluted core of larger volume which would simultaneously have increased the heat transfer area, reduced temperature gradients, and reduced the sensitivity to minor geometrical deviations. The diluted core, however, would have required larger quantities of fissionable material, and it was therefore not recommended. To determine the breeding inherent in this system, the enriched core was surrounded with a blanket of normal uranium. Radially this blanket consisted of an inner blanket of normal uranium rods cooled by the sodium-potassium [fol. 4023] alloy, and an external blanket outside the stainless steel vessel which contained the core, inner blanket and the coolant. This external blanket was composed of normal uranium "bricks" which were perforated with holes so that the "bricks" could be air-cooled. Longitudinal blanketing of the core was accomplished by placing normal uranium slugs in the stainless steel tubes, both above and below the highly enriched uranium-235 core slugs.

Since the EBR-I was to be an experimental unit, it was necessary that each fuel element be separately removable from the reactor. To accomplish this, the fuel elements were fabricated by inserting uranium slugs into properly fitted stainless steel tubes and bonding the uranium to the stainless steel with sodium-potassium alloy within the tube.

Such a fuel element then consisted of central uranium slugs of highly enriched uranium with normal uranium slugs inserted above and below to provide the upper and lower blankets. In the Mark I core, each stainless steel tube was provided with ribs which were milled on the outer surface. When the fuel element was inserted through the upper holding plate and into the lower holding plate and rotated, these ribs came almost in contact with the surfaces of the adjoining fuel elements. The sodium coolant then flowed through the apertures between these fuel elements.

The milling of these ribs on the steel tubes was an expensive and time-consuming operation, so that in the second core made for EBR-1, which we called the Mark II core, the ribs were eliminated and in consequence, the clearance between fuel elements was increased by about 50 mils. Two types of geometrical distortion are obviously possible within this core. One would be a bowing of the [fol. 4024] uranium slugs themselves within the stainless steel tubes. The thickness of the liquid bond between the uranium slugs and the stainless steel wall was 10 mils, so that a bowing of 20 mils within the stainless steel jacket would be possible. Since the flux across the reactor is not uniform but drops off from the center toward the edge, it is clear that the side of each slug toward the center is somewhat hotter than the side away from the center, and consequently, bowing can occur due to temperature differences across the slug. With the coolant flowing over the surface of the steel jackets, these temperature differences are clearly minimized. If the flow of coolant is stopped and in addition, the power is increased rapidly, these temperature differences are magnified, and bowing effects become much more probable.

The second source of geometrical deviation would be in the actual bowing of the stainless steel tubes themselves. In the Mark I core, the presence of the ribs reduced the possibility of this bowing to a matter of a few mils at most throughout the entire length of the tubes. In the Mark II core, however, bowing due to irregular heating could have amounted to as much as 50 mils. It should be noted that the temperature differentials are such that any bowing arising from either source would tend to move

the fuel slugs closer together at the center of the reactor and thus tend to increase the reactivity of the reactor as a whole.

Construction of EBR-I was completed in August, 1951, and the reactor placed in operation. During the lifetime of the Mark I core, the major emphasis was on steady operation to obtain breeding information as quickly as [fol. 4025] possible, and while some experiments were done, no extensive experimental program was carried out. The emphasis was on building up total megawatt days of operation and upon study of the engineering behavior of the system, including the electrical power production. Under certain start-up conditions, particularly when doing foil irradiations, certain operational anomalies were observed. These occurred only under extreme operating conditions and were totally absent during routine operation.

With the introduction of the second, or Mark II core, rather extensive experimental programs were undertaken to determine the nuclear characteristics of the reactor. During this phase of the reactor's operation, less emphasis was placed on routine operation and consequently, more occasions arose on which the operational anomalies were observed. These consisted of oscillations in power level when the flow rate was drastically reduced, and the appearance of a positive temperature coefficient under circumstances of start-up with very short flux doubling periods and with zero or no coolant flow. It should be emphasized that these anomalies were not characteristic of normal operation and required rather drastic abnormalities in operating procedures for their observation. Under normal operating procedures, the reactor had a definite negative temperature coefficient and very stable operating characteristics. Four years of essentially continuous trouble-free operation were experienced. In my opinion, this attests to its inherent reliability.

When the experimental program that had been outlined for the reactor was completed, the question immediately arose as to whether a final series of experiments should [fol. 4026] not be performed in an attempt to explain the anomalies which had been observed under abnormal

operating conditions. These conditions of reduced or of zero coolant flow and of start-up at very short periods are obviously only procedures undertaken for strictly experimental purposes. To carry out the experiments requires that two automatic safety controls—the flow interlock and the period meter interlock—both be overridden. It is clear that such experiments are fraught with possibilities of damage to the reactor. New high speed instrumentation was added to the reactor, the flow and period meter interlocks were disconnected, and the final series of experiments undertaken. A reactor oscillator was installed which made it possible to increase and decrease the reactor power at variable frequency under the conditions of reduced flow where instabilities earlier had been observed. It was found that for a given frequency of the oscillator, a "resonance" in the power output could be obtained. While harmonics of this resonance frequency were searched for, there was no clear indication of their existence, although if they were of relatively minor magnitude they might have been present without being observed.

The program then shifted to an [illegible]vation of the positive temperature coefficient. The coolant flow was stopped and the reactor started up on a fast enough period so that temperature differentials would be established in the fuel slugs. The characteristic of a positive temperature coefficient immediately appeared; that is, there was an increase in the rate at which the power doubled as the power itself increased. On the final experiment, in which [fol. 4027] the doubling period had been reduced to approximately 0.3 seconds, a delay in scramming the pile permitted the temperature to overshoot so that the uranium became heated above the temperature, roughly 725°C, at which the uranium-iron eutectic forms and the center of the core melted, forming the eutectic. Although the reactor was scrammed manually, the power limitation circuits which had been above the normal trip-level also operated, and it was only the fact that the reactor was on such a short doubling period that permitted it to overshoot to the extent that melting took place. From the control room, it was impossible to tell that anything had gone amiss, although

one thermocouple did indicate a temperature of 590° C, and since it was clear that this might not be a peak temperature, there was some suspicion that the actual temperature rise might have been appreciably higher than this. Within some 15 minutes, however, there were indications of abnormal fission activity both in the coolant and in the stack gas from the building. This activity could only have come from the rupture of a fuel element jacket. The amounts of activity were very low, and although the building was evacuated until precision measurements could be made, the occupants returned immediately thereafter.

Attempts to remove the fuel elements from the reactor core showed very promptly that melting had occurred. While some of the external rods could be removed, by far the greater number could not. This meant that the core would have to be removed as a complete unit from the reactor. The original design had provided for this operation, but it was necessary to erect on top of the reactor a temporary cave to provide radiation protection for the [fol. 4028] operators.

The core was allowed to cool from the time of the incident in November until June before an attempt was made to remove it from the reactor. In the meantime the temporary cave was erected and necessary remote manipulation devices provided. The core itself was removed without incident, placed in a specially designed coffin for radiation protection, and shipped to Argonne National Laboratory at Lemont for detailed examination in July, 1956. One of the caves at Argonne was made gas-tight so that the inspection of the core could be carried out in an inert atmosphere to reduce any possibility of the sodium which still clung to the fuel rods catching on fire and thus initiating a uranium fire. When the cave had been adapted, the core was removed from its coffin and examined in detail. I personally participated in this examination, and I also have studied the photographs and analyses made of the core. Most of the outside rods could be removed without difficulty. Many of the steel jackets of these outside rods, however, had been penetrated by iron-uranium eutectic which dissolves steel with great readiness. The iron-uranium eutectic formed in the center of the core had

obviously been ejected from the core center outwards between the fuel elements displacing sodium and interacting with the steel jackets of the outside fuel elements. The uranium slugs in the outside fuel elements were intact and undamaged.

In the center of the core, where the melting would first have occurred, no semblance of fuel tubes or fuel slugs could be observed. The average density of the core assembly before the incident was approximately 10.5 grams per [fol. 4029] cubic centimeter. This represented an average of the actual quantities of uranium, stainless steel, and sodium. The density of the material removed from the center of the core after the meltdown was approximately 4 grams per cubic centimeter. This means that much of the uranium originally in the center of the core after alloying with the iron had been ejected possibly by bubbles of boiling sodium-potassium alloy to the outer regions of the core. This central material was very porous, much like volcanic tuffa. Surrounding this central zone was a layer of slightly more dense material, with a density of approximately 6 or 7 grams per cubic centimeter, and outside of this zone melting apparently did not occur. Directly below the center low-density core was a region in which there was material of approximately 14 or 15 grams per cubic centimeter, as if part of the eutectic had settled into this area and then solidified. Below this layer there had been no melting of the fuel elements and they could be readily broken away.

It is impossible to state that this melting phenomenon actually stopped the reactor in this instance, since the operator did hit the scram button and since the power limitation circuits also operated properly. The observed meltdown phenomenon therefore conceivably occurred after the reactor was shut down by its safety circuits. However, it is clear to me that the observed meltdown would have stopped the reactor if the safety circuits had not done so, although further melting might have occurred had the reactor had to wait for this mechanism to be fully operative. In my opinion, the results of this experiment indicate that in the process of a meltdown of a sodium-cooled fast reactor [fol. 4030] core the core tends to disassemble itself, reducing

the reactivity and power level and acting as an added and automatic safety device.

A more detailed analysis of the core after the meltdown phenomenon is now in progress, and this investigation will undoubtedly give further quantitative data on the effect of a meltdown in reducing the reactivity of a fast reactor core. In my opinion it will give an even more definitive indication that this phenomenon is an effective control measure in preventing major hazards in fast reactors of this general type.

This final series of experiments determined without question that the EBR-I Mark II core did have an unexplained instability at low coolant flow rates, and that it did have a positive temperature coefficient for zero flow and for fast start-up periods. The most probable explanation of this positive temperature coefficient is that it resulted from bowing, but the experiment itself, of course, offers no proof that this is true. The observed instabilities in turn may be due to some type of thermal feed-back, but again it is not clear from the experiment itself what the origin of this feed-back is. Consequently, it is proposed to carry out a new set of experiments on EBR-I which I believe will definitively answer these questions.

Two changes are being made. The basic coolant flow of the reactor is being modified. In both the Mark I and Mark II cores, the sodium-potassium alloy first flowed down through the inner blanket and then up through the core, from there out to the heat exchanger, to the pumps, to the hold-up gravity tank, and thence back to the inner blanket. This flow pattern is being modified so that the flow can either follow this series pattern or, as an alternative [fol. 4031] pattern, the sodium-potassium alloy can flow independently in parallel streams through the core and through the inner blanket simultaneously. (Parallel flow is presently planned for the proposed PRDC reactor.) This change from one flow pattern to the other should give an indication as to the nature of thermal feed-backs if they are associated with coolant flow when the oscillator experiment is repeated with the new core.

The second major change is that the third, or Mark III, core is being built as a fully rigid core. Instead of using

stainless tubes with uranium slugs thermally bonded to the stainless steel with sodium-potassium alloy, the new core is being formed of co-extruded zirconium jackets on the uranium. This will prevent any possibility of bowing of the fuel slugs within the tubes. Each fuel element is being provided with detachable ribs so that when the core is assembled and clamped together, it will form a rigid assembly in which bowing is practically impossible. If bowing is the source of the positive temperature coefficient, the design of the new core should reduce this positive temperature coefficient very greatly, if not completely eliminate it. As a check on this experiment, the core will be disassembled and the ribs will be removed except at the top and the bottom of each fuel assembly. When re-clamped, the modified Mark III core will be rigid at the top and at the bottom but will be free to bow in the center. This will lead to an increased positive temperature coefficient in the modified case, if in fact the positive temperature coefficient is, as I believe it is, due to bowing. In any event, these experiments will provide an unmistakable check on whether this is the source of the positive temperature coefficient observed in EBR-I.

[fol. 4032] In my opinion, the proposed EBR-I program using the Mark III core will demonstrate that the positive temperature coefficient and probably the observed instability at low coolant flow rates were due to bowing of the fuel elements and to series coolant flow, or a combination of these factors. If this is so, these undesirable characteristics can be eliminated by relatively simple design changes, and will in fact be eliminated by the design presently proposed for the PRDC reactor as described in the PRDC Application for License. In any event, however, I believe that the proposed EBR-I program will almost certainly provide the answer to the source of the positive temperature coefficient and instabilities observed in EBR-I with the Mark II core, and when this answer is definitively obtained I am confident that these undesirable features can be eliminated by engineering or design changes.

Another important result which I believe will be obtained from the EBR-I program is verification of the validity of the use of an oscillator as a safe and reliable means for

exploring the operating characteristics of a fast reactor and the determination of the presence or absence of any operating instabilities. In my opinion, information already available indicates that this technique is both safe and reliable, but the oscillator experiments we plan to conduct on EBR-I, should eliminate all reasonable doubt on this score.

The results of the EBR-I program should begin to be available during the summer of 1957. While it may prove profitable to carry on oscillator experiments as a continuing investigative tool for a relatively long period of time, it appears that the basic results for both investigations should [fol. 4033] be available within the coming year, which is in ample time for the application of any new data obtained to the final core designs of both the EBR-II and PRDC reactors.

Joint ANL-LASL Fast Reactor Safety Program

Quite apart from the further EBR-I program I have just described, the very fact that EBR-I gave four years of trouble-free operation using first the Mark I and then the Mark II core, and the further fact that the Mark II core was carried through the much-discussed and much worried-about "meltdown" with no damage except to the core itself, provides encouraging assurance with respect to the normal, power-production operation of a well-designed fast breeder reactor. In addition, however, a further extensive research and experimental program is planned with respect to the possible results of unpredicted concatenations of malfunctions, or of highly skilled sabotage of such a reactor.

Control of a reactor depends on the rate at which the reactor power increases and this in turn depends on how fast the reactor's neutron population increases. The population increase in turn depends on the percentage in numbers—the "excess reactivity"—per generation and on the length of time until each member of one generation has provided his progeny for the next. It happens that most of the neutrons provide their new progeny promptly, but there is always one group which dallies in making its

appearance, the "delayed" neutrons. These come not from the fission process itself but from nuclear reorganization within the fission product atoms produced by the fission act. [fol. 4034] Reorganizations take time, so that as long as the neutrons from this group are an essential part of those required to maintain or increase the population, it is their generation lifetime that determines the rate of increase.

Only when the excess reactivity is so great—"prompt critical"—that the prompt individuals themselves can maintain or increase—"excess above prompt critical"—the population does their characteristic generation time become controlling. One of the safety objectives in the design of any reactor—thermal or fast—is to avoid the possibility that the reactor may become "prompt critical." Since the time for "prompt" multiplication is much shorter than that for the "delayed" group, it is thus always the objective to design for a maximum excess reactivity obtainable in any reactor less than that required for prompt critical; if the total amount of excess reactivity available is not enough to make the reactor prompt critical, the danger of this occurring is obviously minimized. Due to the fact that absorption probabilities are in general higher for neutrons of velocities characteristic of thermal reactors than for those found in fast reactors and due particularly to the spectacular thermal absorption due to xenon, one of the products of the fission product decay process, it is much easier to meet this criterion of small excess reactivity in the design of a fast power producing reactor than it is for a similar purpose thermal reactor; in other words, a thermal reactor usually requires that considerably greater excess reactivity be available than does a fast reactor. This is one of the advantages of a fast reactor over a thermal reactor, and as a result the fast power reactor in normal operation is [fol. 4035] at least as safe as and in some ways safer than a thermal reactor designed for the same service."

On the other hand, if prompt critical is passed, the power in a fast reactor will increase a great many times faster than will be the case in a thermal reactor. The short "prompt" neutron lifetime associated with a fast reactor is the basis of the worry concerning what might happen if in fact it should somehow become prompt critical. Thus,

while a fast reactor can be so designed that untoward incidents are much less likely to happen than in the case of a thermal reactor, if such incidents do occur the results may theoretically be of much greater magnitude.

It should be kept clearly in mind that unless the magnitude of the accident is such as to breach the structure housing the reactor, the containment provided by it will prevent any damage beyond that to the reactor itself. It is conceivable that a structure could be designed strong enough to contain almost any specified explosion. The provision of an extreme housing facility would obviously be a last resort in any power plant designed to be economically feasible, however, because of its excessive cost. This makes it imperative to determine the actual situation with regard to such incidents as completely as is possible. In the case of the EBR-I incident, the results were insignificant. While the core was destroyed, the remainder of the reactor, including the inner blanket, was undamaged. Other available information indicates that under no circumstances developable in a fast reactor could an explosion occur which would even approach that of an A-bomb. It is clear that there [fol. 4036] is no credible possibility that a reactor could be a bomb. The problem on which we are still working, however, is to determine just what forces could be released by the maximum accident which might credibly occur.

A joint program between Los Alamos Scientific Laboratory and Argonne National Laboratory has been established to obtain the answers. Los Alamos has well tested computational techniques for determining the explosive efficiency of various assembly geometries and assembly procedures and has the needed experimental data to interpret the calculations. Argonne has a major backlog of calculations and experimental results on fast reactor designs, including reactor control and kinetics. It is believed that the joint effort of the two groups, each bringing its own specialized competence to bear on this problem, will provide the information needed to give positive answers at least within the "order of magnitude" range within the year. I believe that the results of this work will show that the maximum credible accident of a reactor of the general type proposed by PRDC will be containable.

In order to make assurance doubly sure, Argonne National Laboratory is also proposing to build a nuclear "meltdown" facility to determine precisely the mechanics of the meltdown phenomenon for specific types of fuel elements and for sub-assemblies of such fuel elements. This will be done with the test specimens both in air and in static liquid metal coolant. It is believed that a significant explosion can occur only if the core is first melted. If this be true, these experiments on the mechanism of melting become important, as they will then supply the detailed information needed for precise calculations of the type [fol. 4037] outlined above. The Los Alamos group have agreed to assist with the really difficult instrumentation problems inherent in obtaining quantitative data from such "fast excursion" experiments. While no guarantee of success can be given, it is hoped to have such a facility ready for operation within a year to eighteen months in order to provide data to the group carrying out the explosion calculations at the earliest date possible. With such data, the answers to the "containment" problem should be essentially definitive and they should be available by January, 1959, in advance of both the EBR-II and the PRDC reactor start-ups.

It is not, of course, absolutely certain at this time that such a nuclear meltdown facility can be satisfactorily designed and built in time to meet this schedule, but the work is being vigorously pursued and it is hoped that we will be able to do so. While such actual experimentation is not in my opinion essential to a final safety determination, such experimentation would provide additional verification of the computations being made by furnishing an experimental check on the nature of the "assembly procedures" assumed.

Fast Zero Power Reactor Program (ZPR-III)

The art of reactor computation has for several years been essentially an exact science for uranium fueled thermal reactors. Until very recently, however, this was not true for fast reactors. As late as 1951 even the critical mass calculation for EBR-I was in error by more than twenty-five per cent. It was clear that energetic steps had to be

taken to remedy this situation. Detailed study of all of [fol. 4038] the many micro cross-sections involved and their variations with energy throughout the energy range from fission energy down to thermal energy would have been the direct and straightforward approach. Unfortunately this approach would not have provided the data in time. A more direct, if less elegant, approach was essential for the prompt development of fast reactor systems.

The first approach taken was to utilize the EBR-I itself as an experimental tool to determine as many of the parameters needed for fast reactor calculations as possible. In this connection a major effort was made to determine the neutron "energy spectrum" throughout the reactor core. This involved the development of new measuring devices and new experimental techniques. The study did give a measure of the relative numbers of neutrons as a function of velocity from fission energy down to thermal at various points throughout the core and blanket. This made it possible to check the validity of "educated guesses" as to the values of various numbers used in the fast reactor calculations. It was also possible to measure the "averaged" cross-sections of important materials in a variety of quite different neutron velocity distributions. This again provided valuable new data which could be used to check computational methods.

It was clear that EBR-I itself was too inflexible to provide the wide variety of data needed to explore all the facets of fast reactor theory. It was fine for the objectives for which it had been designed but the very fact that it was primarily a power reactor meant that it lacked the flexibility [fol. 4039] imperative in an experimental facility for a thorough and complete investigation of fast reactor physics. Consequently, the Laboratory proposed a Fast Zero Power Reactor, ZPR-III, which was designed specifically to serve this purpose. Moreover, it would serve at a later date as a facility for checking the detailed reactor physics of the EBR-II core and of the PRDC core long before those reactors were ready for start-up. The Atomic Energy Commission approved the proposal, the facility was designed, and in order to provide the greatest possible flexibility in experimental program, it was built at

Argonne's Idaho Division laboratory at the National Reactor Testing Station in Idaho. It was placed in operation in October of 1955 and is now engaged in a program of experiments to provide the data required for the improvement of the precision and reliability of fast reactor calculations. Agreement between calculation and experimental observation has already become excellent and has served to verify many quantitative predictions of fast reactor theory. As this program continues, I am sure that it will serve to make the art of fast reactor computation as exact a science as thermal reactor computation has become.

It was clear when approval was given for ZPR-III that it would take many months for its completion. Consequently, ZPR-I was rebuilt at the Chicago site to provide an essentially zero power thermal "source pile" to serve as a copious neutron supply for a fast "exponential" or "sub-critical" assembly. This unit, ZPR-IV, made possible an early start on the problem of determining the parameters needed for fast reactor calculations. Since ZPR-III, being self-critical, is so much more sensitive and potent a tool for [fol. 4040] the purpose than ZPR-IV, the latter was decommissioned shortly after the ZPR-III start-up. It had served its purpose in pushing ahead the schedule for establishing a sound basis for fast reactor theory.

Not only have ZPR-IV and ZPR-III provided the basis on which fast reactor calculations can be carried out with full confidence in their results, but ZPR-III has provided another real contribution to confidence in inherent fast reactor safety. One haunting area of ignorance in reactor theory in general has been the question of the so-called "Doppler effect." One way that nuclei capture neutrons in their immediate neighborhood is through "resonance." Put very crudely, if a neutron is travelling at just the right speed the nucleus acts as if it had a revolving door which let the neutron pass right inside. If the neutron is going either faster or slower than this "resonance speed" it acts as if it bounced back or got knocked out of the way. There is a little latitude in the speed it can have, but not much.

Obviously this mechanism strictly limits the number of neutrons that can enter this nucleus. If this particular

"resonance" lets in neutrons which result in fission, it is clear that this limits the number of fissions that are going to be produced; the nuclei have to wait around until a neutron of just the right speed comes along. Now if you "heat up" the nuclei, this merely means that you start them dashing around with speeds of their own, the speed depending on how hot they get, the hotter, the faster. Now, if a nucleus dashes toward a neutron, the neutron itself will have to be going a little slower than the "resonance speed" if it wants to get through the revolving door. It [fol. 4041] would have to be going faster than the "resonance speed" to get in the door if the nucleus were running away from it. It is clear, however, that with both neutrons and nuclei in motion there is an increased number of neutrons—those with somewhat higher or lower speeds than the "resonance speed"—that can now enter and produce fission. The "resonance" has been "broadened." This would mean that if the temperature of the fuel in a reactor were raised it would result in a greater number of fissions than when cool, and other things being equal the number of progeny in succeeding generations would go up—the reactor would have a "positive temperature coefficient." Clearly the effect exists, but how big is it? Could the "positive" coefficient of EBR-I be due to a Doppler broadening? If the effect were of the magnitude which reasonable calculations would predict, the answer was "no" but there were no experimental data to prove the validity of the calculation. There might be an anomalous effect of which we were ignorant.

To test this experimentally the EBR-I core was mocked up in ZPR-III in such a way that fuel could be electrically heated and actual measurements made on the change in reactivity. The experiment is extremely difficult to perform because the effects expected are small. However, it was shown in the very first experiments that the effect is no larger than the theoretical calculation predicted within the temperature range it was possible to use in the experiment. Further work using more sensitive instrumentation and a larger temperature range has been completed and provides data accurate enough to make possible reliable calculations. The observed effect was only one-fifth of that pre-

[fol. 4042] dicted by early calculations. It is quite clear that this particular effect is not responsible for the positive coefficient in FBR-I. It will provide no problem in either the EBR-II or the PRDC reactors. This answer is now definite.

In addition to the general fast reactor physics experiments of the kinds so far described, ZPR-III is scheduled to make detailed studies of the physics of both EBR-II and the PRDC reactor. These investigations will include critical size determinations and detailed flux distribution studies. The latter will provide the power distribution data required for final design check on coolant flow, core stress, etc., before the reactor goes into operation. The control rod patterns will be studied in detail both as to "reactivity worth" and as to modification of flux and therefore power distribution. Danger coefficient measurements will be made to determine the relative importance from a reactivity standpoint of the different fuel locations within the core. Finally, the effect on the reactivity of displacing part of the fuel axially out of the core to one end, simulating the effect of melting and dripping, will be determined in order to give a measure of the way in which the reactivity would change and how rapidly if part of the core were to melt. The PRDC reactor experiments will be undertaken beginning early in 1958, depending on how fast the necessary fuel pieces can be fabricated. The complete set of experiments will require approximately a year for completion. In the meantime the EBR-II experiments will be carried out. Since it is not clear that they can be completed by the end of 1957 and since all of the important general experiments [fol. 4043] would be delayed for two years under the above program, the Atomic Energy Commission has authorized the construction of still an additional Zero Power Reactor facility. The Laboratory is presently engaged in the design of this facility and hopes to have it in operation early in 1958. This will make possible full investigation of the problems of both EBR-II and of the PRDC reactor without interference between them. In both cases the investigations will be completed in adequate time to meet the established schedules for the respective reactors.

It will be noted from this discussion that months of experimental work must be done before definitive answers are available to be supplied to the Commission as a basis for its determination as to the ultimate safety of any particular fast breeder reactor. Some of the necessary studies have been under way more than a year. The construction schedules of EBR-II and the PRDC reactor are such that the experimental data will be available in time to be utilized.

The Second Experimental Breeder (EBR-II) Program

The first experimental breeder reactor, EBR-I, was designed to meet strictly limited and highly specific objectives. The first of these was to prove that breeding—the production of more fissionable material during reactor operation than the reactor burns—was not only a theoretical possibility but an actual, technically achievable goal for future power reactor designs. The second objective was to establish the feasibility of the use of a liquid metal coolant—sodium potassium alloy in this case—as a sound [fol. 4044] engineering technology which could be relied upon in power reactor design work. The third objective was to demonstrate that even such an experimental device could produce significant quantities of reliable electrical power.

EBR-I fulfilled its objectives with signal success. It demonstrated that in its operation at least as much plutonium was produced as there was uranium-235 fuel burned. The sodium potassium alloy cooling system yielded trouble-free operation throughout the four years that the reactor was in steady operation after initial shakedown difficulties were remedied. Finally, upon demand, the electrical generating system provided the two hundred or so kilowatts of electrical energy required to operate the reactor and the associated laboratory activities in a thoroughly reliable manner.

The importance of this proof of the technical feasibility of breeding should be clearly realized. "Coal" which consisted of one hundred thirty-nine parts of rock and one part of burnable carbon would be considered pretty poor stuff as a fuel. Conceivably, the one part of carbon might be separated out and burned, but clearly the use of coal would

be quite a different matter were this to be the actual situation. This is, however, almost the situation where normal uranium is concerned. Normal uranium contains only one part of the fissionable uranium-235 to one hundred thirty-nine parts of uranium-238. The uranium-235 can be separated and burned, but the process is costly and it leaves the uranium-238 as a practically useless residue.

Imagine now that by some strange scientific process, when the one part of carbon is burned within the one hundred [fol. 4045] thirty-nine parts of rock it transforms a part of this rock into a new burnable material and this new material in burning in its turn transforms still more rock to new burnable material. If for every pound of carbon or new burnable material burned a pound of new burnable material were formed, it is clear that most of the "coal" would be burned; thus, although it might look like poor stuff at first glance, in fact it would make a usable fuel without the costly separation process. Moreover, it now becomes an economic fuel source because it represents a total energy supply one hundred and forty times as large as that available in the original carbon. Clearly, the separation of the carbon to be burned separately, thus rendering the rock useless, could only be justified by high priority needs. The world's fuel supplies are finite, and willfully to dissipate such a major fraction of one of the potentially major energy sources would be inconceivable.

No such scientific process is known for our postulated carbon-rock composite "coal"; however, such a process *is* known for the uranium-235–uranium-238 fuel.

In the act of fissioning the uranium-235 atom bursts into two fragments, thus forming two smaller atoms, and at the same time it ejects some left-over neutrons. Ideally, a fission occurring in pure uranium-235 would only need to eject one left-over neutron in order to produce a continuing reaction, provided the body of uranium-235 were infinite in size. Each left-over neutron would eventually enter a uranium-235 nucleus, produce the fission act, and result in a new left-over neutron. This would simply keep on going [fol. 4046] indefinitely. The ideal case is not quite as simple as pictured, however, because occasionally a left-over neutron enters a uranium-235 nucleus in such a way that it can

be tolerated without causing the fission eruption; it produces uranium-236 instead. This being the case, each fission act must produce on the average more than a single left-over neutron if the reaction is to continue.

In reality the situation is much worse. No body of material is infinite in size so some of the left-over neutrons leak out of the uranium-235. Others are absorbed in the structural materials used to position the uranium. Since the probability that a neutron will cause fission in a uranium-235 atom increases as the neutron speed is reduced, moderating materials are introduced into the system so that the neutrons will get slowed down like a sprinter dashing into a mob of holiday shoppers—he is soon slowed to the pace of the crowd. These moderators also absorb some of the left-over neutrons. Moreover, each fission act produces heat. To remove the heat requires a cooling system and this in turn provides new materials to absorb the left-over neutrons. Fortunately, when uranium-235 fissions, it produces on the average approximately 2.5 left-over neutrons per fission act. This number is large enough so that, with care, every fission act leaves at least one left-over neutron to carry on the reaction, the others being absorbed in the materials of construction or controls, or leaking out of the system.

When one of the materials of construction happens to be uranium-238 a new phenomenon enters the picture. This material, like other materials of construction, absorbs neutrons, but in this instance the neutron transforms the [fol. 4047] uranium-238 into uranium-239, which by radioactive decay becomes plutonium-239. Plutonium-239 is a "burnable" material in the same sense that uranium-235 is "burnable." If now by careful design the loss of left-over neutrons to leakage, to absorption, and to structural materials and controls can be kept to less than half of a left-over neutron for each fission that occurs, one neutron would be left for capture in uranium-238 to produce plutonium, and the quantity of plutonium so produced would in this instance be equal to the quantity of uranium-235 burned.

In a reactor burning pure uranium-235, fission-produced ash builds up as the burning process continues, and these

fission products are in many instances strong neutron absorbers, particularly for neutrons that have been slowed down to thermal energies. This means that in effect, new fuel must be continually added to the reactor to maintain the general reaction, otherwise the absorption effects would soon rob the necessary left-over neutron from the uranium-235 reaction. Rather than add new fuel continuously, it is customary to put in originally more fuel than is needed and to balance this excess fuel with excess absorption in the form of control rods which can be removed as fission-produced poisons build up.

In a reactor using uranium-238 as well as uranium-235, the formation of new burnable material in the form of plutonium-239 makes necessary a much smaller allowance in excess fuel put in originally to take care of burn-up. The uranium-238 transformed to plutonium-239 is the equivalent of the addition of fuel or the removal of a control rod. Theoretically, it should be possible to design a re- [fol. 4048] actor in which the neutron economy is so good that the production of plutonium and its subsequent burning to produce additional plutonium would enable the reactor to burn practically all of the uranium-238. Practically, this is impossible in a heterogeneous reactor because the accumulation of fission products eventually causes changes in the natural character of the fuel element, such that the fuel element must be removed for reprocessing in order to remove the fission products and restore it to its original metallurgical condition. Nevertheless, the production or breeding of plutonium from the burning of uranium-235 or other nuclear fuel is of enormous importance from the standpoint of fuel conservation as well as reactor economy and efficiency.

Thermal or moderated reactors were the first to be built because the probability of a slow neutron being captured in uranium-235 is very much higher than it is if the same neutron had essentially fission energy. This means that a much smaller quantity of uranium-235 is required to reach critical size, with consequent reduction of fuel inventory.

On the other hand, the absorption coefficients of various structural materials and the probability that uranium-235 or, more importantly, that plutonium-239 will absorb a neu-

tron without producing fission are very much less for neutrons of high energy—that is, moving with extremely high speeds—than for thermal energies. This decrease of capture probability also holds for all of the fission product ash that is produced in the fissioning of uranium-235 and plutonium-239. Moreover, uranium-238 itself occasionally will fission when it absorbs an extremely fast neutron. These factors make it clear that it should be possible to ob- [fol. 4049] tain a very much better neutron economy in a fast reactor than is possible with a thermal reactor. Added to the above considerations, if the neutrons are to be kept at as high energies as possible, no moderator is needed and consequently losses by absorption to a moderator are also eliminated. The price that one pays for this increased neutron economy lies in the fact that the probability of fission has decreased and this in turn means a larger critical mass and therefore greater fuel inventory.

Here again it should be pointed out that in the fast breeder, due to the formation of new fissionable material in quantities equal to or greater than the quantity burned and due to the lowered probabilities of absorption, the amount of excess reactivity which must be built into the reactor to provide satisfactory operating periods between reloadings is very small compared with the thermal reactor. In the PRDC reactor, for example, the amount of excess reactivity that must be built into the reactor and balanced by the control at operating temperature is less than that required to take the reactor to prompt critical.

To summarize, if uranium is to supply the significant energy reserves for the future which it should supply, uranium-235 "burner-uppers" are definitely ruled out. Nuclear reactors for power purposes must be designed with such high neutron economy that at the worst, approximately one new atom of fissionable material is produced for each atom fissioned, or, if possible, even more fissionable material is produced than is burned. The clearest immediate road to this goal lies in the design of fast-neutron breeder reactors, and this type of reactor presently gives the only [fol. 4050] technologically proven avenue toward achieving this goal.

Against this background the EBR-I accomplishments become highly significant. As pointed out earlier, EBR-I was purposely made as small as possible to cut down on the required quantities of uranium-235. This very smallness insured high leakage. If the EBR-I would breed at all, a large power breeder could be designed to produce more fissionable material than it burned with a high degree of certainty. That the EBR-I did produce at least as much fissionable material as it used assured the nation that nuclear power is not only a specialty power source dependent on pure separated uranium-235, but also a potential economically competitive central station power source with essentially all of the uranium—both 235 and 238—available for energy production. Further, EBR-I demonstrated that liquid metal cooling provided not only a technically feasible system but also one compatible with a successful breeding neutron economy. The problems are no longer those of basic feasibility; the problems are now those of "scale-up" and of the associated chemical and metallurgical processes necessary to remove excess fission product ash from the core fuel elements and excess new fissionable material from the breeding blanket with high efficiency, so that the "breeding gain" of the reactor will not become a "cycle deficit" due to processing losses.

EBR-II and the PRDC reactor designs are both based on this same EBR-I foundation. In keeping with the difference in objectives of the PRDC organization and of Argonne National Laboratory, these two reactors are designed to achieve very different goals. The PRDC reactor is designed [fol. 4051] to demonstrate the production of as nearly economically competitive power as is possible, and to do so with as few deviations as possible from EBR-I proven principles and technologies. EBR-II, on the other hand, is designed as an engineering test facility; it is a tool for the scientist and engineer, not primarily a power production installation.

The EBR-II facility has been designed to achieve the following objectives:

1. It provides the smallest possible unit with which to test out reactor components scaled up to full production plant size—full scale capacity would be achieved

by multiplying the number of components used, not by increase in the size of the units.

2. It incorporates a chemical and metallurgical pilot plant to test out the chemical separation and metallurgical refabrication processes required to achieve a complete, successful breeding cycle.

3. It includes new departures in sodium cooled, fast reactor technology and will therefore provide operational test of new features designed to simplify construction, improve neutron economy and increase reliability of plant operation.

4. It will yield the information needed not only to provide cost data on its own operation but also that [fol. 4052] required to evaluate costs for other proposed fast breeder reactors and to establish the economic future of reactors of this type, and

5. It will eventually furnish an excellent facility for operational testing of new fuel element designs at high temperature and high neutron and gamma fluxes to determine their thermal and mechanical behavior and their irradiation characteristics.

Although the PRDC reactor has been described in detail in the PRDC License Application, and the details of the EBR-II conceptual design have been published in Geneva Paper #501, a brief comparison of certain major items of the two designs is instructive.

The EBR-II and the PRDC reactor are both sodium-cooled, unmoderated reactors. The EBR-II is an experimental nuclear power plant which will produce 60 megawatts of heat and 20 megawatts of electrical power. Its primary purpose is to develop information relating to nuclear power plants of this type. Since it is a maximum developmental experimental facility, it incorporates flexibility in its design. The PRDC reactor is a prototype central station nuclear power plant which will produce 300 megawatts of heat and 100 megawatts of electricity. Its primary purpose is to demonstrate the feasibility of the production of electrical power to be supplied at the lowest possible

cost and highest dependability to an electrical distribution system.

Although the plants differ in power rating and in primary [fol. 4053] purpose, the PRDC reactor is similar to EBR-II in many significant areas of design and operation. The operation of EBR-II, therefore, will contribute significantly to the proving out of technology applicable to the PRDC reactor.

The PRDC reactor is similar to EBR-II in the following areas:

1. Neutron Spectrum and Flux.

These reactors both operate with a fast neutron flux in excess of 10^{15} neutrons per square centimeter per second. This exceeds present experience by a factor of more than ten, and information obtained from EBR-II will contribute significantly to the PRDC reactor.

2. Power Density (power generation per unit volume of the core).

The PRDC reactor has a core volume of approximately 335 liters in which approximately 270 megawatts of heat is generated, with a resultant power density of approximately 800 kilowatts per liter of volume. The EBR-II core has a volume of approximately 50 liters and produces approximately 50 megawatts of heat with a resultant power density of approximately 1,000 kilowatts per liter of volume. These are very high thermal ratings, and EBR-II experience will be applicable to the PRDC reactor.

3. Fuel Element and Fuel Subassembly.

The PRDC fuel element is very similar to the EBR-II fuel element. They are both small diameter pins of essentially the same size. The PRDC fuel element is jacketed in a thin tube of zirconium, while the EBR-II fuel element is jacketed in a thin tube of stainless steel. These differences are due to different fabrication processes to be employed, but the fuel elements should exhibit similar [fol. 4054] operational characteristics.

In each reactor a cluster of fuel elements is contained in a box or subassembly. In the PRDC reactor 144 elements are contained in a 2.65 in. square subassembly. In the EBR-II, 91 fuel elements are contained in a hexagonal subassembly 2.29 in. across flats. The subassemblies are quite similar in size and should exhibit similar operational characteristics.

4. Primary Sodium Coolant Operating Conditions.

The EBR-II primary sodium enters the reactor at 750F, flows at a maximum velocity of 27 fps through the reactor, and leaves at a temperature of 900F. The PRDC primary sodium enters the reactor at 550F, flows through the reactor at a maximum velocity of 30 fps. and leaves at a temperature of 800F. Although the EBR-II flow conditions are more severe in some respects, the coolant operating conditions are quite similar.

5. Coolant System Flow Arrangement.

Both reactors are cooled by sodium flowing through the core and blanket in parallel. The coolant is supplied to lower plenum chambers which supply coolant to the two regions in the reactor. The coolant flows upward through the reactor to heat exchangers. Upward flow was selected for each reactor to conform with natural connection which is employed to remove fission product decay heat in the reactors after shutdown.

6. Heat Transfer Circuits.

Both reactors employ a non-radioactive secondary sodium system to transfer the heat from the primary sodium [fol. 4055] system to the steam generator, and to isolate the reactor system from the steam system. The plants, therefore, will include similar plant control for over-all operation of these heat transfer systems, i.e., primary sodium, secondary sodium, and steam systems.

The major differences between the two plants pertain to size and purpose. The PRDC reactor is considerably larger, and therefore includes an inherent advantage with

respect to one aspect of operational stability. Because of the larger reactor volume, it will use a lower enrichment fuel, which increases the possibility of a negative Doppler coefficient. Since the magnitude of the Doppler coefficient for EBR-I has been shown to be a very small positive quantity, and since the contribution of U-238 is negative, the over-all coefficient in a more dilute system (lower enrichment) will be still smaller than EBR-I and might actually be negative.

Although the PRDC plant is approximately five times as large as the EBR-II plant, the PRDC system employs three separate heat transfer circuits, while the EBR-II employs only one circuit. Each PRDC circuit, therefore, is less than twice the capacity of the EBR-II circuit, and the engineering development of sodium system components for EBR-II, such as pumps, valves, and flow instrumentation will contribute significantly to the PRDC plant.

The PRDC reactor is designed for a demonstration central station power plant and is based on known technology to the fullest extent possible. The EBR-II is designed for maximum developmental flexibility and includes certain [fol. 4056] features which are perhaps more advanced, and represent a larger deviation from known technology.

Some of the significant differences in plant designs include the following:

1. Reactor and Primary Coolant System Arrangements.

The EBR-II employs a tank-type arrangement for the reactor and primary coolant system in which the reactor and primary coolant system are contained in a single, large vessel and operate submerged in sodium. This arrangement offers certain advantages in compactness of design and in minimizing of some of the problems of sodium plumbing in the coolant system. It requires, however, that sodium system components, such as pumps, heat exchangers, and flow instrumentation operate submerged in high temperature sodium. System components of this type had to be developed to meet these requirements.

The PRDC reactor and primary coolant system are arranged in a more conventional manner with the reactor

contained in a reactor vessel with external piping, pumps, and heat exchangers. This arrangement is similar to all sodium-cooled reactor systems employed to date, and therefore applies the technology already developed.

2. Reactor Control.

The EBR-II reactor employs movable fuel as the method for controlling the reactor. This system permits high neutron efficiency in the reactor, since the control material contributes to the neutron economy of the reactor. Since [fol. 4057] large quantities of energy are being generated in the control units, it is necessary to provide reliable cooling to these units during operation. Providing adequate cooling to these movable units introduces severe engineering problems.

The PRDC reactor employs a neutron poison to effect reactor control. Because neutrons are absorbed parasitically in the control units, this control system reduces the neutron efficiency of the reactor. The heat generation in the control units is quite small and the cooling problem is avoided.

3. Fuel Subassembly Hold-down System.

Both reactors employ high velocity coolant flow upward through the reactor which tends to raise the subassemblies out of the reactor. In the EBR-II, a hydraulic system is employed to provide a resultant downward hydraulic force on each subassembly. This is a rather unique approach to the problem and has not been demonstrated in any existing reactor. The PRDC reactor employs a mechanical system to support and position the subassemblies. Similar arrangements have been successfully employed in other reactors.

4. Sodium Pumps.

The EBR-II reactor system will employ two or three different types of sodium pumps. A variety of pump types is employed (a) to meet the peculiar requirements of sub-

merged operation in the primary system, and (b) to permit operational evaluation of different types of sodium pumps. This latter purpose is in accordance with the over-all objectives of the EBR-II to advance the technology of this type of reactor.

[fol. 4058] The PRDC plant employs only one type of sodium pump which will permit lower costs, because several identical units will be produced and, since only one type of pump will be employed in the entire plant, maintenance will be simplified.

It is clear that much of the information to be obtained from EBR-II and the engineering tests associated with its design and construction are directly applicable to the PRDC reactor. The architect-engineer is already at work on the detailed engineering design of EBR-II. Construction is scheduled to start in May, 1957, and to be completed in January, 1959. Argonne National Laboratory will install the reactor core and associated equipment during the first half of 1959, and reactor start-up is scheduled for June and July, 1959.

In my opinion the extensive research and development work being done in connection with EBR-II, and the experience which will be obtained in its start-up and operation prior to scheduled loading of the core in the PRDC reactor, will supply substantial additional information with respect to the safety of operation of the proposed PRDC reactor. I believe that this information will confirm that the PRDC reactor, or any other well-designed reactor of this general type, can be operated safely for the generation of electric power.

General Reactor Engineering Work Relevant to PRDC Reactor

Two general reactor engineering programs at Argonne National Laboratory have particular relevance to the PRDC reactor project. These are the fuel element irradi- [fol. 4059] ation program and the engineering test work on sodium technology and sodium system components.

The Laboratory has been engaged in studying the thermal, corrosion, and irradiation behavior of fuel materials

and prototype fuel elements since the war days. These studies have included investigations of fabrication techniques and of alloying materials on the corrosion characteristics and on the thermal and irradiation stability of uranium and recently of plutonium and thorium fuel elements. The observed behaviors have been correlated with the physical metallurgical characteristics of the test specimens, and while the field is still far from being thoroughly understood, tremendous strides have been and are being taken in improving this situation. All of this work is directly relevant to the PRDC reactor design and in my opinion has been and is being used to provide that reactor with a satisfactory fuel material.

In addition to the basic study of fuel materials, an intensive program of testing prototype fuel pins in the Laboratory's CP-5 research reactor has been under way for the EBR-II for two years, and tests are just getting under way for the PRDC reactor. In this connection the power level of the CP-5 reactor has already been doubled from 1,000 kilowatts to 2,000 kilowatts in order to double its available flux and a further power doubling to 4,000 kilowatts is under consideration. The higher flux level yields significant information in proportionally shorter time.

Prototype fuel elements for the EBR-II reactor have been under test in the Materials Testing Reactor (MTR) at the National Reactor Testing Station for approximately [fol. 4060] six months.

In my opinion any information needed with respect to the behavior of the proposed fuel elements for both reactors will be in hand well before fabrication of the respective cores is required for either EBR-II or the PRDC reactor.

In the field of sodium technology, the Laboratory has had a continuing program of investigation since 1945. This work was started during the development of EBR-I and has continued essentially without interruption. It has involved the development of both AC and DC electro-magnetic pumps and DC homo-polar generator current sources, of

mechanical pumps and bearings, of sp[illegible]l valves, of pipe heating systems to maintain sodium abov[illegible] its melting point, of flow meters, pressure gauges, level indicators and other necessary instrumentation, and of the many specialized pieces of equipment needed in reactor control, loading, unloading, and the like. It has also involved the development of methods of removing oxygen from the liquid metal system almost completely, and of maintaining purified inert atmospheres above all free liquid metal surfaces. A very large volume of such technological information has been developed not only at Argonne National Laboratory but also at the Knolls Atomic Power Laboratory and at the Atomics International Laboratory. This body of technology has been fully utilized in both the EBR-II and the PRDC reactor designs.

In addition, an approximate half scale mechanical mock-up of the EBR-II has been under continual test using design operating conditions for 16 months in order [fol. 4061] to test all of the necessary special mechanical parts, not only for operability and reliability but also for life span. So far all equipment has functioned perfectly. PRDC has a similar mock-up of their reactor under way for similar tests, as Mr. Amorosi has explained in his testimony.

The Laboratory has also commenced operation of performance tests on full-scale components for the EBR-II. At the present time two full-scale loops are in operation testing an AC electro-magnetic pump in one and a mechanical pump in the other, together with the associated valves and instrumentation. A third full-scale loop to test a DC electro-magnetic pump will be put into operation shortly. These pumps, valves, and associated equipment are of the same general size as those required for the PRDC reactor and the operating information is being made currently available to PRDC.

It is my opinion that most of the information of this character needed to be included in the PRDC Application for License is presently available, and that any remainder will certainly be available prior to loading of the core.

Summary

To summarize, it is my opinion that in the national interest it is important that a full-scale industrial fast breeder be built and tested at the earliest possible time. A research and development laboratory is not generally possessed of the operations philosophy requisite in the design of a plant to be operated as a successful industrial unit, even for demonstration purposes. Such a central station power plant must be designed under the close and [fol. 4062] continuing scrutiny of a competent production organization. In this way the operating and maintenance features essential to low-cost operation can be integrated into the design.

The program and the time schedule of the cognate work in progress at Argonne National Laboratory is such that substantial nuclear information and specialized technological developments required to complete the PRDC project will be provided by the Laboratory before PRDC will be ready to load nuclear fuel into its reactor. While the Laboratory's schedules for the ZPR-III and EBR-II projects are admittedly tight, I can offer assurance that to the extent that they are within the control of the Laboratory we will use our best efforts to meet them.

Finally, I am of the opinion that, on the basis of present knowledge and theoretical physics, a fast breeder reactor of the general type proposed by PRDC can be constructed in such a way that it will be safe for operation in a populated area. I am further of the opinion that, prior to the time the PRDC reactor is to be started up, additional information and operating experience with other reactors of the general type will provide adequate confirmation of this opinion.

[fol. 4064] In evidence January 8, 1957. Tr. 44

BEFORE THE ATOMIC ENERGY COMMISSION

Docket No. F-16

In The Matter Of

POWER REACTOR DEVELOPMENT COMPANY

TESTIMONY OF W. KENNETH DAVIS,
DIRECTOR, DIVISION OF REACTOR DEVELOPMENT,
UNITED STATES ATOMIC ENERGY COMMISSION

Personal Qualifications

My name is W. Kenneth Davis. I am Director of the Division of Reactor Development of the United States Atomic Energy Commission.

I was born in Seattle, Washington, on July 26, 1918. After graduation from high school in Oakland, California, I studied in the College of Chemistry of the University of California for two and one-half years. I then transferred to the Massachusetts Institute of Technology, where I received a Bachelor of Science degree in Chemical Engineering in 1940. Following this, I spent a year attending the M. I. T. School of Chemical Engineering Practice, and another year as Assistant Director of the Buffalo Station of this School. This Station was located in the Lackawanna Plant of the Bethlehem Steel Company. I passed the doctoral examination and was engaged in thesis work but did not complete the thesis after outbreak of World War II, in December 1941. I had given serious consideration to [fol. 4065] work on the separation of uranium isotopes by ion exchange but gave this up in favor of work on gaseous combustion which could be carried out at Buffalo. I received a Master of Science degree in Chemical Engineering in 1942.

In June 1942 I began work for the Research and Development Department of the Standard Oil Company of Cali-

fornia which later became the California Research Corporation, a wholly-owned subsidiary of the Standard Oil Company of California. Here my work was primarily in process design and engineering development although several months were spent in technical service work on an aviation gasoline plant. Principal development projects were on butadiene manufacture and catalytic cracking processes. In May 1945 I was made Acting Group Supervisor, and in May 1946, Senior Research Engineer.

In October 1947 I went to work as a Senior Engineer for Ford, Bacon and Davis, Inc., of New York City. They assigned me to their project in Chicago where they were architect-engineers for the new Argonne National Laboratory facilities. It was my responsibility to work with the laboratory personnel and with the company's engineers to arrive at facilities which would meet the laboratory's requirements. During the course of this work I had a great deal to do with the design of the Chemistry and Chemical Engineering Buildings, and with all the Temporary Laboratory Buildings. I was also responsible for the mechanical [fol. 4066] engineering on some of the Temporary Laboratory Buildings. Among other things, I personally supervised preparation of the first cost estimate for the Experimental Breeder Reactor (No. 1), after reviewing its design. Aside from this type of work, I did not have any direct connection with reactor development work during this period.

In May 1949, I joined the faculty of the University of California at Los Angeles as associate professor of engineering. As chairman of the chemical engineering committee I was responsible for building up staff, initiating curricula and courses, and acquiring laboratory facilities for process and chemical engineering. I was active on a group seeking (unsuccessfully) to obtain a research reactor in the Los Angeles area, or, specifically at the University of California. I also organized the material for a senior-level course in nuclear engineering. During the period at the University of California I engaged in a substantial amount of industrial consulting work. I was promoted to the rank of professor on July 1, 1953, while on leave-of-absence.

In December 1950 I was given leave to join the California Research and Development Company at San Francisco, Berkeley, and Livermore, California. This company was formed as a subsidiary of the California Research Corporation to undertake research and development for the U. S. Atomic Energy Commission in cooperation with the [fol. 4067] University of California Radiation Laboratory. The work done by the company was on the development, design, construction, and operation of very high current linear accelerators. I had the task of hiring, organizing, and directing a group to do research and development work on the target for the accelerator.

In the summer of 1952 the A. E. C. Division of Reactor Development asked the Company to undertake research and development on fast reactors in collaboration with the Argonne National Laboratory. An intensive program was begun on fast reactors under my direction. In October the research and development department was re-organized and I was designated Manager of the Research Division, with the additional responsibility for the fast reactor project as such. Unfortunately, budgetary limitations resulted in the curtailment of this program late in 1953. The Company finally ceased operation in mid 1954.

I joined the Division of Reactor Development of the Atomic Energy Commission in April 1954 as Assistant Director-Technical. In August 1954 I was appointed Deputy Director, I was appointed Director of the Division of Reactor Development in February 1955. In my present capacity I am in charge of and have responsibility for all reactor development work for the Commission, including the Aircraft Reactor Program, the Army Reactors Program, the Civilian Power Reactor Program, and the Naval Reactors Program. Supplementary to these primary activities [fol. 4068] are many research and development activities concerned with the development of reactors, including a broad program for basic development of power reactors, including chemical processing. Among the reactor activities for which I am responsible are those at National Reactor Testing Station, Argonne National Laboratory Los Alamos Scientific Laboratory, Knolls Atomic Power Laboratory, Brookhaven National Laboratory, Oak Ridge National

Laboratory, and others. I specifically have responsibility for the execution of the Commission's fast reactor program.

Because of this administrative responsibility, as well as my previous personal work on fast reactor research, I have followed fast reactor development relatively closely since joining the AEC. I am familiar with this development to date, including specifically the history of the EBR-I, the development and plans for EBR-II, the development and plans for the PRDC reactor, and the work done by the United Kingdom. Although I have not, of course, had an opportunity to read all of the pertinent technical reports, nor to go through the various technical arguments in mathematical detail, I have maintained a continuous technical interest in these reactors to the extent that I am knowledgeable regarding them and their various problems and difficulties, as well as the formal development programs for them.

[fol. 4069] *The History and Development of Fast Reactors*

The United States Atomic Energy Commission's interest in fast reactors goes back to at least 1945, in which year both the Argonne National Laboratory (then called the Argonne Forest Laboratory) and Los Alamos Scientific Laboratory submitted proposals to the Manhattan Engineering District to design and construct one fast reactor by each laboratory. The resulting Los Alamos fast reactor was designated "Clementine", the Argonne reactor was called the Experimental Breeder Reactor, now known as the Experimental Breeder Reactor No. I (EBR-I). I shall discuss each of these in more detail later in my testimony.

In addition to these two reactors, each of which was operated for several years, a number of unmoderated reactors and critical assemblies in which the fissions were due to fast neutrons have been operated in both the United States and England. From experiments with these assemblies, considerable experience and nuclear physics data have been obtained which are of definite assistance in the design of fast power reactors.

A brief description of the fast critical assemblies and reactors already constructed and operated will give an indication of the type of data on fast reactors already available, and will indicate the variety of loadings and

materials used. These machines may be conveniently [fol. 4070] divided into three classes: (a) small highly-enriched critical experiments, (b) flexible critical experiments and (c) fast neutron reactors.

(a) *Small highly-enriched critical experiments.*

Since a large variety of basic nuclear information is most easily and economically obtained from simple uncomplicated experiments a number of such experiments have been run on unmoderated systems.

Lady Godiva. At Los Alamos Scientific Laboratory a bare, spherical critical assembly of roughly 6¾ inch diameter using U^{235} metal enriched to about 90 percent has been in operation since August 1951. This assembly is known as "Lady Godiva." It has no cooling system; thus, its maximum power is limited to 1 kw level during continuous operation.

The assembly consists of three parts which are mechanically assembled by remote control. After the assembly has been put into its spherical shape, delayed neutron criticality is achieved by insertion of two 7/16 inch diameter control rods made of U^{235}.

During remote operation, progress of the assembly operation is shown by closed-circuit television of the set-up, signal lights and selsyn-driven indicators coupled to moving parts of the assembly apparatus. Interlocks are used to assure that the assembly operation is carried out in only a certain safe sequence. Detectors for fast neutrons have [fol. 4071] been used for indicating the assembly power level and also for initiating scram signals for automatic immediate shutdown when the power level is higher than a preset value or if the period is shorter than a preset value. These neutron detectors in conjunction with automatic control circuits, permit power level to be effectively maintained at some set value. Two types of experiments have been run with Godiva. The first type was run with the assembly critical on delayed neutrons. In the second type the assembly was subjected to sufficient reactivity to be critical on prompt neutrons alone; these experiments are called "prompt burst" experiments.

With the delayed critical experiments, much physics data has been obtained. Data on the nuclear properties of materials applicable to fast neutrons have been difficult to obtain. In most cases the techniques which have been most successful in thermal reactors cannot be used for obtaining fast neutron data. Values for nuclear cross sections must generally be arrived at by the more indirect methods of comparing theoretical prediction and experimental results from integral experiments in which several parameters vary.

The effect of several materials on reactivity when placed in different radial positions within Godiva was measured experimentally. These data were used to estimate the transport cross sections of those materials. The transport cross [fol.4072] sections are most important for calculations on fast reactors. The neutron spectrum was also estimated by measuring the results of irradiating various fissionable isotopes and other materials of known energy-dependent cross sections.

In addition to the delayed critical experiments, a number of experiments have been run with Godiva prompt critical. In order to make these prompt-burst experiments possible, a third uranium control rod worth about one dollar in reactivity was added which could be rapidly shot into the assembly. With these experiments it was possible to observe from the neutron level, that, for instantaneous reactivity insertions up to about ten cents above prompt critical, the assembly expanded due to heating sufficiently to reduce the reactivity to below prompt critical in less than a millisecond. In other words, there is a sudden increase of power level to high values but of such short duration that the total energy release is relatively small. During the burst, power build-up of simple assemblies such as Godiva is determined by the prompt neutron lifetime, but the self-limiting characteristics resulting from thermal expansion cause the power build-up rate after the burst to be determined by the delayed neutron lifetimes and the remaining excess reactivity.

[fol. 4073] The experimentally demonstrated self-limiting feature of nuclear assemblies such as Godiva when made just greater than prompt critical are important to increas-

ing our understanding of critical assembly behavior. But also important is the success which has been demonstrated in predicting this kinetic behavior by calculation. Success in correlating calculated behavior with experimental behavior provides greater confidence in calculations which cannot be experimentally observed.

Prompt neutron bursts were used as a source of fast neutrons for irradiation of materials fissionable by fast neutrons such that the yields and decay constants of the delayed neutrons produced by fast neutron fissions could be measured.

Jezebel. A later fast critical assembly at Los Alamos Scientific Laboratory is called "Jezebel." It is a bare sphere made of plutonium operated at low power. The size, construction, and operation of this device are similar to that described for Godiva. Experimental data from it will be used to obtain more accurate parameters for plutonium for use in calculations.

Topsy. "Topsy" was the name given to a small reflected critical assembly which was operated for 8 years at Los Alamos before being disassembled. This uncooled machine consisted of four main subassemblies. These were a 16-[fol. 4074] foot track section, carriage, safety test section, and critical assembly section. The core was assembled on the carriage which was movable along the track section. The core section could then be raised into either the safety test section or the critical assembly section by remote control actuation of the carriage hydraulic lift.

When it was desirable to estimate a safe mass limit for hand-stacking the active material in the core unit of the carriage lift, the core could be remotely lifted into a toroidal water tank safety test unit.

To form a critical assembly, the core was lifted into the hollow reflector which had been stacked on the stationary critical assembly unit. Because of the flexibility available with handstacking, experiments were made with different core densities and compositions. Critical mass was determined for spherical uranium cores of 50 to 90 per cent enrichment and from 50 to 100 per cent density, using a natural uranium reflector. The effect of the use of nickel as a reflector as compared with natural uranium metal

was determined for cores of both 90 per cent enriched uranium metal and uranium hydride. Some experiments were also run using a spherical plutonium core and natural uranium reflector. These experimental data were obtained for the simple geometrical shape such that the results could be [fol. 4075] checked more readily by calculation. The variety of assemblies presented a range of tests for determining the accuracy of nuclear data and reactor physics calculations of reflected, fast reactors.

The assemblies were operated at delayed critical at powers up to 1 kw for the purpose of obtaining data which could be used to derive values of the apparent absorption and transport cross sections of several materials. The method was similar to that used with Godiva.

As in Godiva some data was obtained on the relative fission rates of U-235 and U-238 at various radii. These data were used as indications of the neutron spectra which could serve as checks on the reactor physics calculations for the assemblies.

Zephyr. Still another uncooled, small fast critical assembly, called "Zephyr" and consisting of a plutonium core surrounded by a natural uranium envelope has been in operation at the Atomic Energy Research Establishment at Harwell, England since February 1954.

(b) *Flexible Critical Experiments.*

ZPR-III. When the feasibility of large fast power reactors had been established and designs for them were under way, it became desirable to have available a fast critical assembly for the larger, more dilute fast reactors. Prior to 1955, all critical assemblies had used rather small, highly enriched cores, except for the few exploratory investiga- [fol. 4076] tions of assemblies of lower enrichment and densities using "Topsy" which I have already described.

An uncooled fast critical facility, designed to permit investigations of a wide range of sodium-cooled fast power reactor designs, has been constructed at the National Reactor Testing Station by Argonne National Laboratory. It is known as "Zero Power Reactor III" (ZPR-III). The first loading of ZPR-III went critical in October 1955. I

shall discuss later in some detail the experimental and research program which is planned in connection with ZPR-III, and its importance in providing data relevant to both the design features and safety of start-up and operation of other proposed large power reactors, including the PRDC reactor.

Zeus. Another large uncooled reflected critical assembly facility has been built in England and went into operation in December 1955 at the Atomic Energy Research Establishment at Harwell, England. This facility is known as "Zeus." This reactor is used for studying generally the nuclear characteristics of a variety of dilute large fast reactors using U-235.

(c) *Fast Neutron Reactors.*

Clementine. The first cooled fast reactor was built at Los Alamos Scientific Laboratory in accordance with a de- [fol. 4077] sign conceived in early 1945. Clementine was designed and built primarily to provide a high intensity source of fast neutrons. In addition it permitted study of the control of fast reactors, study of breeding possibilities, and study of power production principles on a limited basis. Valuable information was obtained in these areas.

Clementine was a fast reactor having an average neutron energy in the range of 500 kev with a fast flux of 4.3×10^{12} at 25 Kw. The fuel was plutonium rods, nickel coated, and canned with mild steel, and about 6.5" long and 0.7" in diameter. The rods were held in a mild steel cylindrical cage and had a central or peripheral loading. Positions not filled with plutonium were filled with uranium rods to complete the total of 55 positions.

The fuel cage was contained in the reactor pot and was a gas-tight unit. The fuel was cooled by mercury because Na and NaK technology was not developed at that time. The mercury entered through two holes on opposite sides of the bottom of the pot and left through one hole above the center of the cage.

The fuel cage was in the center of a cube of uranium-238 which was the reflector. Four sides of the cube each had a window which was the start of a special test hole or

column. The windows were of thorium, uranium, steel or bismuth. There were other test holes which were tapped to various depths in the reflector.

[fol. 4078] The reflector was cooled by water running through tubes in its outside surface. The reflector cube was surrounded by steel bricks and then lead bricks. This cube was sealed in an air-tight aluminum envelope and flushed with helium.

The remainder of the shielding was composed of layers of steel, masonite, alternating layers of boron plastic and steel and on the outside with an aggregate of concrete and lead shot.

Control was maintained by four vertical rods, two shim and two control, at the corners of the sides of the uranium reflector adjacent to the pot. Their downward movement replaced uranium with boron. Part of the uranium reflector in the shape of a cone below the pot acted as a safety block and was held in by a magnetic clutch.

The mercury coolant was pressurized with helium and circulated by an electromagnetic pump. It was cooled by two water heat-exchangers.

Rupture of a fuel element and subsequent contamination of the mercury with plutonium caused the reactor to be shut down and later dismantled in December 1952, after approximately six years of operation. It had accomplished the research and experimental objectives for which it had been built.

[fol. 4079] *EBR-I.* The second cooled fast reactor and the first nuclear reactor to produce electric power was the Experimental Breeder Reactor No. I (EBR-I), designed and built by the Argonne National Laboratory at the National Reactor Testing Station in Idaho. This reactor was based upon a design conceived by Doctors Enrico Fermi and Walter Zinn in 1945, and was approved as a research and development program by the Manhattan Engineering District late in that year. The Commission approved the EBR-I as a construction project in November 1947. The reactor was located at the National Reactor Testing Station (NRTS) in Idaho in order to permit maximum flexibility in experimentation. The EBR-I went critical in August 1951; electricity was first generated in December 1951.

The principal objectives sought to be accomplished by the construction and operation of EBR-I were testing of the possibility of breeding and the obtaining of data on reactor operation in a high-energy neutron range, and in handling and containing NaK at high temperature.

The core and inner blanket are contained in a stainless steel tank. Two cores have been used and a third is being designed.

The first two cores were composed of stainless steel tubes filled with rods of uranium which had a NaK bond between the uranium and the tubing. A hexagonal stainless steel partition separates the core from the inner [fol. 4080] blanket. The blanket rods were natural uranium and the core rods had 7½" of highly enriched uranium in the center with 8" of natural uranium on one end and 4¾" of natural uranium on the other.

Surrounding the NaK cooled inner blanket and core is the external uranium blanket. The uranium is in the form of stainless steel clad bricks and is air-cooled. This blanket has holes for eight external safety rods and four external control rods. The external blanket is assembled on an elevator that can be raised and lowered to aid in reactor control. At the base of the reactor tank is a safety plug which is part of the external blanket. This plug is held in position by air pressure and in the event of power failure or "scram" moves away from the reactor tank.

Outside the external blanket is a graphite reflector 19" thick and this is surrounded by about 9' of concrete. Five beam holes pierce the shielding and reflector for utilization of the high energy neutron flux. Experimental facilities also include a thermal column and "rabbit" hole.

The core and internal blanket of the reactor are cooled with NaK which is circulated through a heat exchanger which transfers heat to a second NaK loop which, in turn, transfers the heat to boiling water in a second heat ex- [fol. 4081] changer. All NaK systems are kept under an inert atmosphere to preclude fire from NaK contact with water or moist air.

As mentioned previously, this reactor produced electricity from nuclear energy for the first time in the world on December 29, 1951. It operated successfully until No-

vember 29, 1955. On the latter date, in the course of a difficult experiment, the EBR-I underwent a power excursion which resulted in damaging the reactor's core; Dr. Norman Hilberry's testimony includes a description of this incident. Action is being taken to replace the damaged core with a new one. Extensive additional research and experimentation is planned with this new core.

(d) *Miscellaneous.*

Three other projects in or related to the fast reactor field should also be mentioned. In 1946 the Manhattan Engineering District contracted with the General Electric Company to contribute to the reactor development program. This contract resulted in the construction of the Knolls Atomic Power Laboratory. This laboratory chose to concentrate its efforts in the exploration of the possibilities of breeding and power production in a reactor whose average neutron energies were in the intermediate range. In 1949 serious consideration was given by the Commission to the construction of a 10,000 kilowatt reactor at [fol. 4082] West Milton, near Schenectady, New York, for the purpose of demonstrating breeding and power generation. However, subsequent information became available which raised questions of technical feasibility of breeding in the intermediate neutron energy range, and this in turn resulted in the Commission's deferring construction on the proposed intermediate neutron breeder reactor. The experimental information and knowledge gained in this program was not lost, however, but was applied to a large extent in the development of the Submarine Intermediate Reactor (SIR). Since 1953 a small number of KAPL scientists have investigated various fast reactor systems such as a fast breeder reactor concept which would utilize plutonium oxide as its fuel. Design studies, supported by irradiation data on plutonium oxide fuels, have indicated that such a reactor system appears feasible.

In 1952 the California Research and Development Company at Livermore, California, with which I was then connected, undertook a fast reactor research and development program, pursuant to a contract with the Commission. In

1953 this work was terminated for budgetary reasons. Prior to such termination, however, many valuable studies were made by the California Research and Development Company on fast reactors. The basic design for the Los Alamos Molten Plutonium Reactor Experiment (LAMPRE) one of the fast reactors now to be constructed for the Com- [fol. 4083] mission was proposed by CR&D in March 1953, based on the earlier work on plutonium alloys done at Los Alamos.

Finally, in addition to the Commission programs, mention should be made of the research and development work which has been under way for several years by Atomic Power Development Associates, Inc. (APDA). I understand that other witnesses will cover this in more detail.

THE AEC FAST REACTOR PROGRAM

Objectives. The development of power reactors where the bulk of the fissions are produced by high energy neutrons—the fast reactor program—is one of the important civilian power reactor development programs of the United States Atomic Energy Commission. The Commission's interest in fast neutron reactors stems from information obtained from experiments and studies which indicate that the fast neutron reactor may have important potential advantages over thermal reactors for the economic development of nuclear electric energy. In my opinion, the fast breeder reactor is one of the promising types for the development of electric power on a commercially feasible basis, and I consider it of considerable importance that the United States demonstrate its continuing leadership in the peaceful application of nuclear energy by successfully developing this type of reactor. The proposed re- [fol. 4084] actor of Power Reactor Development Company (PRDC) can, I believe, be an important part of this demonstration, and it is on this basis that the Commission has accepted PRDC's proposal as a basis for negotiation of a contract with PRDC in connection with the Commission's Power Reactor Development Program. I shall discuss this further at a later point in my testimony.

Some of the advantages of the fast neutron reactor over the thermal reactor for the generation of electric power are:

1. Because the parasitic or non-productive capture cross section of uranium-235 and plutonium is low in the fast neutron spectrum, neutrons are utilized more efficiently than in thermal neutron reactors. This contributes to the possibility of successful breeding.

2. In fast neutron reactors, the chain reaction is sustained by neutrons whose energies range from several million electron volts down to about fifty thousand electron volts. In this energy region significant quantities of U-238 will fission and this amounts to a bonus of over 10 per cent in total fissions.

3. The decrease in reactivity due to the build-up of fission products is nearly negligible in a fast reactor.

[fol. 4085] 4. Fast reactors require less excess "reactivity in hand," and by proper design can probably be operated with less than $1.00 excess reactivity, whereas thermal reactors usually require over $10.00 excess reactivity in the clean-cold condition in order to reach operating temperatures and to override xenon poisoning. However, fast reactors are generally more sensitive to changes in dimensions and geometry distortions than are thermal reactors.

5. Because the neutron capture cross sections of structural materials is low in the fast neutron spectrum, there is considerably more latitude in the selection of reactor structural materials.

6. Fast reactors are characterized by small volumes and compactness. As technology improves, it appears reasonable to hope that fast reactor plants will be relatively inexpensive to construct.

Coupled with these established advantages, the fast reactor presents some unique problems which are receiving extensive further study. These problems may be broadly classified as having to do with (i) engineering, (ii) nuclear

operating stability, and (iii) possible results of a credible meltdown accident.

[fol. 4086] (i) The principal novel engineering problems are:

1. Because the development of equipment to handle sodium and sodium-potassium is not as far advanced as equipment for water-reactor systems, progress in the development of fast reactors has been largely limited by the rate at which satisfactory sodium and potassium-sodium components could be developed, since hydrogenous coolants cannot be used in fast reactors.

2. The necessity for removal of very large amounts of heat from the small core volume of a fast reactor necessarily presents design problems. Because the heat released per unit volume is necessarily higher in fast than in other types of reactors, the problem of adequately cooling the core is also necessarily greater.

(ii) Problems having to do with the nuclear operating stability of fast reactors have, I believe, been over-emphasized by the EBR-I meltdown incident, which I shall discuss later. Additional experimental work is nevertheless required in order to show the best way in which they can definitively be solved. These problems may be considered generally as:

[fol. 4087] 1. The factor or factors responsible for the prompt positive temperature coefficient and for the nuclear instability found in EBR-I must be positively determined.

2. The magnitude and sign of the Doppler effect on fast reactors must be quantitatively determined.

3. Pile-oscillation experiments must be performed on fast reactors to demonstrate conclusively that such experiments are feasible and are capable of being interpreted to give reliable information.

(iii) The third group of problems presented by fast reactors is found in the possible results of a meltdown acci-

dent. As both Dr. Hilberry and Dr. Bethe have pointed out in their testimony, the actual effect of the EBR I meltdown in the presence of sodium provides promise that this problem may not be as severe as some may have expected. The fact that fast reactors contain substantially more enriched U-235 than do thermal reactors of equivalent power, the fact that these reactors are somewhat more sensitive to geometry than thermal reactors, the fact that reactivity may be substantially increased by the accidental introduction of a moderator, and the fact that on meltdown of a fast reactor the formation of a critical mass might result in greater energy release, nevertheless make further research and experimentation in this field desirable. The [fol. 4088] problems to be dealt with in such research and experimentation principally are:

1. The probability and consequences of the formation of a critical assembly during a fast reactor core meltdown. To be explored by both theoretical studies and by experiments to determine the manner in which fuel elements melt during a power excursion.

2. The probability of containing the forces released in a maximum credible accident for fast reactor designs, including those for EBR-II and the PRDC reactors.

The first group of these problems—the engineering problems—although related to safety, concern most directly the satisfactory operating characteristics of the reactor. These problems have been and are being studied in both the AEC and PRDC programs. I also am confident that the results of these programs, including the substantial additional experience to be obtained during start-up and operation of EBR-II, will provide important further data in this field. Additional assurance should be derived from the operating experience to be obtained with the sodium-cooled fast breeder reactor being built by the British at Dounreay, Scotland, to which I shall refer later.

[fol. 4089] The second and third groups of problems—nuclear operating stability and possible meltdown—are being explored in various phases of the AEC fast reactor

program. In addition, valuable information and practical operating experience is expected to be obtained from the British. In my opinion, these programs should at least point the way to satisfactory solutions to these problems prior to the scheduled completion date of the proposed PRDC reactor.

I shall now discuss in more or less detail certain phases of the AEC fast reactor program, with emphasis on those activities which have particular bearing on fast-reactor safety. This program will be considered in several parts:

(1) Reconstruction and continued operation of EBR-I by Argonne National Laboratory with new cores, to explore the temperature coefficient and stability questions raised by prior experiments.

(2) Design, construction, pile-oscillation testing and operation of a new medium-power fast breeder reactor (EBR-II) by Argonne National Laboratory.

(3) The zero power reactor program and related work, a theoretical and experimental program directed [fol. 4090] towards investigating and improving the characteristics and behavior of fast reactors under normal and transient conditions, including exploratory research and development work on new types of fast reactors and thermal-neutron fast neutron reactors, and basic work on physical constants and properties of importance in all fast reactors.

(4) The design, construction, testing and operation of several new plutonium-fueled fast reactors, the Los Alamos Molten Plutonium Reactor Experiment (LAMPRE) by Los Alamos Scientific Laboratory.

(5) Theoretical and experimental work with respect to the accidental formation of critical assemblies in a fast reactor by meltdown.

(6) Theoretical and experimental work with respect to containment of maximum credible reactor accidents.

(1) *EBR-I.* The design, operation, testing, and meltdown of EBR-I are described by Dr. Norman Hilberry in his

testimony in this proceeding. I agree that in a meltdown of a sodium-cooled fast reactor core a good possibility exists that the reactor would terminate an excursion even [fol. 4091] if its safety circuits failed; that a probable cause of the instability and positive temperature coefficient, exhibited by EBR-I, and its eventual meltdown, was inward bowing of the fuel elements; and that experiments with the proposed Mark III core, which is designed for maximum core rigidity which can be varied for experimental purposes, should, in any event, give a definitive answer as to whether this was the cause of the abnormal behavior of the Mark II core.

I would also like to note that, aside from the inward bowing of fuel elements, two other causes have been suspected to account for the instability noted in the Mark II core under certain operating conditions. It was at first thought that the temperature of the sodium entering the reactor varied, and that this variation was to blame. Experimental measurements proved, however, that the sodium inlet temperature was essentially constant. It was also theorized that the Doppler effect, that phenomenon consisting of an increase in reactivity when the temperature of U-235 is increased, was the cause. However, theoretical calculations indicated that the Doppler effect was too small to account for the instabilities, and this conclusion has now been confirmed by the first of a series of experiments conducted by Argonne on a mock-up of the EBR-I core in a zero power reactor (ZPR-III).

[fol. 4092] That bowing of the fuel elements was probably responsible for the observed positive prompt temperature coefficient is corroborated by the difference in construction between the Mark I and Mark II cores. As Dr. Hilberry points out, the physical construction of the former permitted potentially far less bowing than that of the latter. This fact, taken together with the fact that only minor instability was observed in the Mark I core as compared with the Mark II core, indicates the likelihood that bowing and instability are closely linked. It is true that the Mark I core, unlike the Mark II, was operated primarily at or near full power with high coolant flow, but there is, in my opinion, a reasonable probability that comparable nuclear instabilities would

have been observed in the low power start-up period, which lasted about a month before the reactor with the Mark I core attained full power. Since none were observed, it seems probable that the Mark I core was in fact more stable than the Mark II.

In the proposed new Mark III core, the annular spacing within the sheathing of each fuel pin will be completely eliminated, since the uranium will be coextruded with zirconium to produce a metallurgically bonded sheathing. In this respect the design is similar to that proposed for the PRDC reactor. Furthermore, as Dr. Hilberry indicates, the Mark III core has been designed so that both the type of [fol. 4093] coolant-flow and the physical limitations on potential bowing can be varied. This flexibility will permit exhaustive experimentation and analysis regarding the factor considered at this time most likely to have caused instabilities, namely bowing of fuel elements.

Oscillator experiments will be conducted on the Mark III core by mechanically varying given amounts of excess reactivity up to about 4 cents, in a sinusoidal pattern as a function of different given frequencies, ranging from about 0.01 to 10 radians per second. Because the amount of excess reactivity can be a figure chosen close to zero, I believe these experiments can be conducted with a high degree of safety. After the pattern of behavior of the reactor becomes known, greater amounts of excess reactivity can be used if required. The resulting power oscillations will be compared to the pattern of the reactivity insertions with particular reference to amplification and phase shift of reactor-output power to reactor-input reactivity. The final results of these tests on the Mark III core will be compared with the results previously obtained in oscillator experiments on the Mark II core in which finite reactivity insertions produced divergent power oscillations in what appeared to be a resonance response. Of course, other kinetic tests are also being considered.

[fol. 4094]. Following completion of experimentation on the rigidized Mark III core, the fuel element pins will be modified so that free bowing of the fuel elements can occur. Pile-oscillator tests, and possibly other tests, will again be conducted with the Mark III core as thus modified so that

the effect of free fuel element bowing upon nuclear instability can be studied. I expect that the Mark III core under these new conditions may exhibit resonances in pile-oscillator tests, although probably of lesser magnitude than those found within the Mark II core, since bowing within the sheathing will not be possible. This should determine whether bowing was the cause of the EBR-I positive prompt temperature coefficient.

The estimated schedule for the EBR-I with the Mark III core is as follows:

In Operation	August 1957
Preliminary Pile-Oscillator Data Available	October 1957
Tests Finished on Rigid Core	April 1958 or earlier
Modification of Rigid to Non-Rigid Core	May 1958
Pile-Oscillator Tests Finished on Non-Rigid Core	December 1958

When these experiments on the stability and fuel element bowing problems have been completed, the Division of Re- [fol. 4095] actor Development and the Argonne National Laboratory will consider loading the EBR-I with a plutonium or plutonium-uranium core which could be available in early 1959. Operational tests on such a Mark IV core of plutonium will probably require one year. There is a possibility that during 1960 the EBR-I would be made into a facility for training reactor engineers and operators.

The results of this proposed EBR-I program should in my opinion serve to isolate the cause of the instabilities which were observed with the Mark II core and indicate appropriate design and engineering corrections which can definitely eliminate them. Before leaving EBR-I, however, I want to emphasize again that the meltdown occurred during an experiment in which extremely abnormal operating conditions were simulated. The fact that EBR-I had previously been operated over considerable periods of time under normal operating conditions, during which time it

showed no significant positive temperature coefficient or instability, is highly important. Indeed, with the exception of the Submarine Thermal Reactor, no other AEC power reactor has operated for so long a period. This experience lends strong support to my view that fast reactors can be so constructed and operated as to be practicable and safe.

(2) *EBR-II.* The Experimental Breeder Reactor No. II will be a fast reactor of advanced design based upon experience gained from the EBR-I. EBR-II will be a two-region reactor which will use uranium-235 fuel at the be-[fol. 4096] ginning, and plutonium alloys as fuel after about two years of operation. It will be located at the National Reactor Testing Station in Idaho.

Upon completion of construction and installation of equipment in EBR-II in 1959, pile-oscillation tests will be conducted over a period of months to determine the presence or absence of undesirable resonances. These experiments will provide further indication also, as to both the safety of such tests and the reliability of results which are obtained from them. If any indication is received of the presence of unsafe resonances, operation of the reactor at significant power levels will be postponed until the cause of these resonances is isolated and the resonances are eliminated by appropriate design modifications. Since by that time we will already have the results of the EBR-I program with the Mark-III core, and will have incorporated into the final design of EBR-II any changes indicated by the results of that program, I am confident that no resonance problem will be found which cannot feasibly be solved.

I believe there is merit in conducting pile-oscillation tests in determining the characteristics of fast (and also of thermal) reactors in the start-up or pre-operational testing phases. The Commission has had considerable experience in conducting such tests.

[fol. 4097] A comparison of the proposed operating parameters of the EBR-I, EBR-II, and Power Reactor Development Company's fast reactor, is given in Exhibit 1, incorporated in and made a part of this testimony. In addition to the fact that the EBR-II will have somewhat higher performance specifications than the PRDC reactor, it will also use more advanced ideas in design, such as:

A. Spent fuel will be reprocessed by pyrometallurgical techniques.

B. Fuel elements will be fabricated by remote procedures.

C. Reactivity changes and shut-down will be accomplished solely by moving fuel.

D. All radioactive "hot" reactor components will be in one container which also is the sodium containing tank.

E. The largest sodium pumps thus far developed will be used.

Although the EBR-II is not a prototype of any specific full-scale power reactor, the information and experience gained from the EBR-II will be of value to fast reactor designers insofar as many components are concerned; *e.g.*, fuel elements, pumps, valves, seals, instruments, etc. The stability characteristics, general performance, and operating characteristics of the EBR-II will be investigated by [fol. 4098] pile-oscillator experiments and will be of great importance in evaluating other fast reactor designs.

The Division of Reactor Development is exploring those practical methods by which the design and construction of the EBR-II can be accelerated. At the present time the Argonne National Laboratory estimates that the EBR-II will be ready for operation about two and one-half years after the Architect-Engineer began the detailed design which was in November, 1956. Its present estimated schedule is as follows:

1. *Construction Phase*

A. A-E Contractor on Duty	November 1956
B. Construction to Start	May 1957
C. Construction Completed	January 1959
D. Equipment Installed	March 1959
E. Reactor Critical	June 1959

2. *Operation and Testing Phase*

A.	Pile-Oscillator Tests	July-December 1959
B.	Steady-State Performance	All of 1960
C.	Steady-State Performance Using Plutonium-Uranium Fuel	All of 1961 and thru 1962

Integrated into the research and developmental activities of the EBR-II is a concerted effort to improve component [fol. 4099] design, efficiency, and general reliability of mechanisms which must be in contact with molten sodium at high temperatures. The ANL Liquid Metal Facilities with the scaled-down mechanical model of the EBR-II, and the three hot sodium loops using the largest capacity sodium pumps thus far developed, have done much to advance the knowledge of the use of sodium as a reactor coolant.

(3) *Zero Power Reactors:* Unlike many other power producing machines, a reactor can operate at essentially zero power with relatively similar behavior and with many of the operating characteristics which it would have at a much higher operating power. Consequently, many of the important nuclear data needed for the development of full-scale reactors can be obtained by using a zero power reactor which is less expensive to construct, of greater flexibility, and more convenient to operate. However, such facilities usually do not utilize power-reactor fuel elements, and do not operate much above room temperature nor contain significant amounts of fission products. I consider two such reactors, Zero Power Reactor No. 3 (ZPR-III) and Zero Power Reactor No. 5 (ZPR-V) to be important parts of the over-all fast reactor program because the ZPR-III is a flexible instrument which will be used to provide important nuclear information to fast reactor designers, and because the ZPR-V is a coupled fast-neutron–thermal-neutron assembly which will increase our understanding of such coupled systems.

[fol. 4100] ZPR-III is a fast zero power reactor located at the EBR-I site at the National Reactor Testing Station at Idaho. It is so designed that nuclear core configurations for specific fast power reactors can be studied and analyzed so

that the final design of a fast reactor can be done with a minimum of uncertainty. ZPR-III has been accurately described in detail in the unclassified Argonne National Laboratory Report ANL-5512, and is also discussed by Dr. Hilberry in his testimony in this proceeding. I will therefore only present its general role in the EBR-II and PRDC design programs.

A comprehensive series of experiments is already under way in ZPR-III to determine the sign and magnitude of the Doppler effect in a fast neutron spectrum. The first such experiments, completed by Argonne National Laboratory in early 1956, showed that the Doppler effect was too small to be measured with the small sample used in the existing experimental setup. Further experiments were started in ZPR-III on October 29, 1956, using improved experimental procedures. Most of this experimental work has now been completed, and final results will be available as soon as the data have been thoroughly analyzed. Preliminary analysis indicates, however, that the room temperature coefficient of the Doppler effect of U-235 in the EBR-I assembly is $+2 \times 10^{-6} \frac{\text{delta k}}{\text{k}}$ per degree centigrade. As Dr. Hilberry [fol. 4101] has stated in his testimony it is clear from this that the Doppler effect could not have been responsible for the positive temperature coefficient in EBR-I, and is actually less than that predicted by earlier calculations.

Another important use to which ZPR-III will be put is in determining the amount of uranium-235 necessary for any specific fast reactor to become critical. Multigroup calculations are not accurate enough to determine the exact critical mass associated with a specific design, but such calculations usually give an estimate of sufficient accuracy to permit a preliminary core and blanket design. However, for the final reactor design, more accurate critical mass data must be obtained so that one can have the assurance that the reactor can be made critical at start-up, and with a core size close to that desired.

By analyzing a simulated reactor core and blanket geometry of a specific reactor design, information can be obtained to minimize excessive neutron leakage in the final core and blanket design, as well as to optimize and deter-

mine the reactivity worth of the control system. Other nuclear parameters of importance can also be determined.

The ZPR-III will be used in experiments to determine the worth of control components which will be incorporated in the designs of both the EBR-II and PRDC pile-oscillation mechanisms.

[fol. 4102] The ZPR-V, located at Lemont, Illinois, can be considered to be a reactor within a reactor: It consists of a five-foot diameter steel tank in which the uranium fuel assemblies and the control rods are placed. In the center of this tank is the fast neutron section and surrounding this section is the slow neutron section. The thermal neutron section contains light-water as the moderator, whereas the fast neutron section cannot have a moderator. The ZPR-V is unique in that the nuclear chain reaction occurs in both regions although they have entirely different nuclear properties.

This two-region critical assembly utilizes the best features of thermal and fast critical assemblies, the ease of control of the thermal section and the improved nuclear performance of the fast section. About ninety-five percent of the neutrons are formed in the fast section and five percent are formed in the thermal section. The reactivity of the entire assembly is varied by controlling the thermal neutrons.

The objectives of the ZPR-V program are to determine the feasibility of scaling up the experiment to a power producing pilot model and of obtaining additional nuclear data in an area in which further exploration is desired.

(4) *LAMPRE.* Although fast breeder reactors of the general type represented by EBR-I, EBR-II, and the proposed [fol. 4103] PRDC reactor are among the more promising for the eventual commercially feasible production of electric power, the fact that they use solid fuels is an economic drawback. Solid fuels limit burn-up of fissionable material because of irradiation damage, and increase the total cost of operations because of the necessity for fuel element fabrication and reprocessing. Looking toward an even more advanced reactor, therefore, consideration has been given to the development of fuels which are non-solid and can operate at very high temperatures; also, it is likely that the heat transfer rates can be increased with molten

fuels. Investigations by Wensch and others, at the Los Alamos Scientific Laboratory in 1949, indicated that a low melting eutectic existed between plutonium and nickel. Other subsequent investigations revealed that lower melting eutectics existed between plutonium and cobalt and plutonium and iron. The compositions of the eutectics are high in plutonium, near 88 atomic percent plutonium, and have melting points ranging from 405°C for plutonium-cobalt, 412°C for plutonium-iron to 465°C for plutonium-nickel. The melting point of plutonium is about 637°C.

In early 1955, the Division of Reactor Development assumed programmatic responsibility for the guidance and direction of the Los Alamos reactor program, and recommended that serious consideration be given to a fast reactor employing a molten fuel. At a previous time the [fol. 4104] Brookhaven National Laboratory had undertaken a program to develop and evaluate a thermal neutron reactor using liquid metal fuel, a solution of uranium in bismuth.

Preliminary investigations have indicated that one of the most difficult technical requirements to meet in the Los Alamos Molten Plutonium Reactor Experiment, designated LAMPRE, is one of providing suitable containment for the molten plutonium alloy. The containing metal must be amenable to fabrication, be inert to molten plutonium and coolant, and have a high melting point. Plutonium is difficult to contain by most metals as it is metallurgically rather active.

Of the many materials investigated by the LASL, tantalum appears to be a promising metal for use in fabricating the core structure. Small-scale laboratory tests reveal that tantalum undergoes insignificant amounts of corrosion when heated in contact with molten plutonium at temperatures up to 1000°C for several thousand hours. Samples containing plutonium in tantalum have been irradiated in the MTR in order to determine the influence of fission products and irradiation upon tantalum stability. The results obtained have been encouraging. Other activities concern reactor control techniques to be used, pyrometallurgical reprocessing of plutonium, and improving sodium coolant properties. The last mentioned activity is important as the

[fol. 4105] sodium coolant must contain very little oxygen, much less than that used in EBR-I, EBR-II, and SRE (Sodium Reactor Experiment) because tantalum is very reactive with even traces of oxygen at high temperatures.

As presently planned, the molten plutonium fast reactor program will be divided into three phases; the design, construction and short-term operation of an experimental reactor, LAMPRE-I; the design, construction and longer term operation of a larger more advanced reactor experiment LAMPRE-II, and possibly the design, construction, and operation of an electrical power producing reactor, LAMPRE-III.

The significance of this type of fast reactor to the solid fuel fast reactor probably lies most in the information on molten alloys that will be obtained. This information should be of importance in analyzing the results of a melt down of a solid-fuel fast reactor. Information obtained on the properties of materials with respect to molten alloys will also be of interest in designing safe solid-fuel fast reactors. Considerable experience will be obtained in techniques to pyrometallurgically reprocess plutonium and in handling large quantities of irradiated plutonium containing fission products.

(5) *Meltdown Calculations and Experiments.* The formation of a secondary critical assembly, resulting from a melting down of a fast reactor core, is a theoretical possibility. [fol. 4106] Because a fast reactor must use enriched fuel, its core can become more reactive if the fuel is brought together more intimately during the meltdown. Although detailed plans are as yet largely unformulated, this represents an area of technology in which important further research and experimentation work will be undertaken.

The melting down of a fast reactor core could be caused by a stoppage of the coolant flow or by a significant increase in reactivity through accident or by any event in which the prompt and decay heat is not removed at a rate sufficient to prevent the melting of the fuel. It is difficult to see how any credible accident to a properly designed fast reactor could in fact lead to a melting down of the reactor core because one can prevent by physical means the addition of reactivity at too rapid a rate, and a complete coolant stop-

page can be made most unlikely. The meltdown of the EBR I core resulted from an excursion during the performance of a very difficult experiment in which the coolant flow was purposely stopped and other devices purposely bypassed. There would be no purpose in conducting such an experiment on a commercial-size reactor. Nevertheless, melting down of a fast reactor core under some hypothetical conditions may increase the reactivity, at least in theory, at a rate sufficiently high to produce an explosive force, but a force many orders of magnitude lower than what is usually associated with even a very small atomic explosion.

[fol. 4107] The AEC program contemplates that idealized models can be evaluated analytically using credible rates of reactivity and the other nuclear parameters which may be associated with the assembly mechanisms considered. Among the various assembly mechanisms which will be considered are the following:

1. Uniform melting and free-fall collapse of the core.
2. Non-uniform melting of the core; *i.e.*, starting first at high neutron flux zones and proceeding to lowest flux zones, and free-fall collapse following melting pattern.
3. Similar melting as described in item 2, but the free-fall collapse to follow an arbitrary pattern seeking a maximum rate of reactivity insertion.
4. The mechanism of terminating a critical assembly will also be studied considering different limiting conditions such as boiling point temperatures of sodium and uranium.

I recognize that theoretical analyses and laboratory investigations of core meltdowns may diverge from the actual behavior of a real reactor core meltdown. For example, meltdown calculations may not take into consideration the decrease in density which in fact occurred when the [fol. 4108] EBR-I core melted down in the presence of sodium, the decrease in density being so great that the critical mass requirements of the core may have increased by a factor of four. However, this decrease in density probably occurred after the reactivity was reduced by the movement of the cup. In the near future the ANL expects

to have a thorough report on EBR-I cores showing (1) a material balance, (2) cause of void formation, and (3) results of core behavior upon initiating the termination of an excursion.

At the present time the ANL is planning to conduct experiments in which uranium will be melted, using electricity, and subsequently dropped into molten sodium. The purpose of such experiments will be to determine whether the volatilization of the sodium will result in forming sodium vapor bubbles or voids in the uranium with an apparent decrease in density similar to what was observed in the EBR-I Mark-II core. If it is found that the density of uranium is decreased in a reproducible manner, then the possibility exists that fast reactors using sodium coolant could terminate an excursion by such a mechanism.

The Argonne National Laboratory and Los Alamos Scientific Laboratory are working in a joint effort on studying many of the problems involved in evaluating what happens when a fast reactor core melts down. Because this joint program has been initiated only recently and because [fol. 4109] of the difficulties involved in investigating such a complex problem, I cannot present a specific programmatic outline at this time, but I can state that both Laboratories are now engaged in developing such a program.

(6) *Containment Calculations and Experiments.* Methods of calculation which have been developed can be used to estimate the energy yields per unit mass of core materials. These estimates can then be used to predict the structure necessary to contain the nuclear-produced forces.

A program of calculation and experimentation is being undertaken by various organizations pursuant to contracts with the Commission, to explore further the containment problem as outlined below:

(a) *Naval Ordnance Laboratory.* This organization, located at White Oak, Maryland is presently engaged in the investigation of the general problem of containing adequately both thermal and fast reactors. Size factors, temperatures of the systems, and rates of loading from simulated excursions are under study. A

specific program is to evaluate the probability of containing a commercial-size fast reactor during a postulated excursion, with particular reference to evaluating the influence of the considerable amounts of shield-
[fol. 4110] ing materials surrounding the core. As an example of a full-scale reactor, the design specifications of the proposed PRDC reactor are to be used by NOL as parameters for portions of these studies, so that substantial containment data with respect to this particular design should be obtained under this program. In this respect shielding materials may dampen or absorb significant amounts of the released forces, but the possibility must also be explored that fragments spalled from the shielding (missiles) could move with high velocities and even penetrate the container. I hope that preliminary results of this specific work will be available before June 1957.

(b) *Aberdeen Proving Ground.* The Ballistics Research Laboratory of this organization is conducting a theoretical and experimental study of outer containment vessels to determine the applicable design criteria which will provide the desired degree of safety. This includes blast and shock phenomena, but not missiles.

(c) *Armour Research Foundation.* This group is investigating shock wave characteristics as related to simulated reactor excursions. Effort is also being expended in a development program to design blast shields for reactors.

[fol. 4111] (d) *Oak Ridge National Laboratory.* Since it is important to know the distribution and characteristics of fission products released in a serious reactor excursion, this laboratory is making experimental melting investigations on sections of irradiated fuel elements.

Conclusion—The Fast Reactor Safety Program.

Considerations of the safety of fast reactors have been an important and integral part of the fast reactor program of the Commission since its very beginning. A substantial

portion of the program which I have just described is directed toward perfecting and proving the design of fast breeder reactors so as to render them safe for operation near populated areas. The following is a summary and schedule of those aspects of the AEC fast reactor program heretofore described which are particularly pertinent to reactor safety:

Objectives	*Estimated Completion Date*
1. Availability of new Doppler Effect Data from ZPR-III in Final Report	March 1957
2. Complete report on Melted-down ERB-I Core	March 1957
3. A. ERB-I Placed in Operation	August 1957
B. Gross Data Obtained from Pile-Oscillator Tests	Mid-October 1957
C. Rigidized Core Experiments Concluded	April 1958
[fol. 4112]	
D. Non-Rigid Core Experiments Completed	January 1959
E. EBR-I Loaded with Plutonium-Uranium Core	February 1959
F. Steady Power Operations Until	June 1960
4. A. EBR-II Critical	June 1959
B. Pile-Oscillator Tests Completed	December 1959
C. Steady Power Testing and Operation	All of 1960
D. Steady Power Testing and Operation Using Plutonium-Uranium Fuel	All of 1961 and 1962
5. LAMPRE-I Begins Operation	About 1958

Objectives	*Estimated Completion Date*
6. A. New Analysis of Melt-Down Problem by ANL with Assistance of LASL	Due Fall 1957
B. Non-Nuclear Melt-down Behavior of Fuel Elements by ANL to Determine if Sodium Volatilization Decreases Uranium Density. Preliminary Data Due	July 1957
C. If necessary, Nuclear Fuel-Element Melt-Down Facility (Borax Type) will be Initiated at NRTS. Borax Unit will supply Neutrons to Melt a Fast Reactor Fuel Element so that Melting Mechanism can be Observed	Undetermined.

The scientific effort being expended in the fast reactor program has increased with each passing year. In fiscal year (FY) 1957 there was a significant increase in scientific [fol. 4113] manpower because the LASL entered into the program. It is expected that the direct scientific manpower will increase up to FY 1960. The indirect scientific manpower, devoted to specialized disciplines related to fast reactor systems such as plutonium fuels technology, pyrometallurgical reprocessing research and development, and others will also increase by a large percentage.

Direct scientific and engineering development manpower is shown for FY's 1956, 57 and 58. The effort shown below for FY 59 and 60 is based upon past experience and reflects what is considered to be an orderly growth rate.

SCIENTIFIC MANPOWER

	FY56	*FY57*	*FY58*	*FY59*	*FY60*
ANL	80	94	135	150	162
LASL	36	43	51	58	65
TOTAL	116	137	186	208	227

The United Kingdom Fast Reactor Program

In February 1956, the Commission and the United Kingdom Atomic Energy Authority approved the exchange of detailed information on fast reactor technology under Section II.A.2 of the existing Agreement for Cooperation between the two countries. There have been several interchanges of visits between the U.K.A.E.A. and ourselves in which valuable design data have been exchanged.

[fol. 4114] I visited the U.K.A.E.A. most recently in October 1956 and had the opportunity to inspect their fast reactor program which is being pursued in a vigorous manner. It was also interesting to observe that about one-third of their total research, development and design manpower available to the entire power reactor development program is engaged in the fast reactor program. In order to stress the importance placed by the U.K.A.E.A. in their fast reactor program, I will describe it briefly below:

The first fast experimental reactor which was designed and built as part of the British program is known as the "Zephyr." It is one of the uncooled small fast critical assemblies to which I referred briefly early in my testimony. It is located at the Atomic Energy Research Establishment (A.E.R.E.) at Harwell, and became critical on February 5, 1954. The British have stated that they intend to use future core loadings of different compositions to extend the data so as to obtain a more comprehensive quantitative knowledge of the nuclear processes which take place in plutonium-fueled fast reactors.

The second experimental fast reactor to be built by the British is named "Zeus," and is also located at Harwell. It is a full-scale, uncooled flexible critical mock-up of the 60-megawatt fast reactor which is to be built at Dounreay, Scotland. It was put into operation on December 22, 1955.

[fol. 4115] Zeus was built primarily to study the neutron characteristics, critical conditions and control calibrations for the Dounreay reactor. The British plan, however, to use Zeus for studying more generally the nuclear characteristics of a variety of dilute large fast reactors, and the data to be obtained from these studies will provide a valuable check on the work to be done along similar lines

in this country. Considerable information on Zephyr and Zeus has been published in the Geneva papers, "Proceedings of the International Conference on the Peaceful Uses of Atomic Energy, 1955."

The first U.K. fast reactor which will produce power is located at Dounreay, in Northern Scotland. It is expected to produce 60 thermal megawatts, which will approximate the output of the EBR-II, 62.5 thermal megawatts. It is a two-region reactor in which the axial blanket is integrated with the core, as in the U.S. designs. Sodium is the coolant, and an intermediate sodium coolant loop is employed. A steel sphere is used for containment.

It is estimated that the Dounreay reactor will become critical in midyear 1958, which will be about one year ahead of the EBR-II and some two years before the PRDC reactor goes critical. In the early part of the Dounreay operation, pile-oscillation experiments will be conducted to determine the inherent kinetic stability of the reactor.

[fol. 4116] I am confident that the Dounreay reactor will provide valuable and important information on such items as the Doppler effect, temperature coefficient, nuclear stability, etc., as well as a test of various engineering designs and the results of actual operating experience. In addition, we shall have the benefit of British research and experimentation, including safety studies, being conducted prior to start-up of the Dounreay reactor. All of this will permit our groups to modify their designs or undertake additional research and development work if necessary.

Relationship of AEC and PRDC Programs

In order to stimulate active industrial participation in the development of reactors, the Commission announced its Power Demonstration Reactor Program on January 10, 1955. The purpose of this program was to provide a framework through which industry could undertake, with Commission assistance and participation, the development, design, construction, and operation of demonstration nuclear power plants. This invitation to industry recognized that many industrial organizations interested in nuclear power did not have access to sufficient research and development

facilities and lacked the resources to absorb all of the excess costs of development, design, construction and operation of demonstration nuclear power plants.

[fol. 4117] In response to the Commission's invitation, the Power Reactor Development Company (PRDC) submitted a proposal to the Commission on March 30, 1955, in which the Company proposed to construct and operate a commercial-size fast reactor power plant, and requested that the AEC undertake certain research and development work having a direct bearing upon the safety and feasibility of the proposed PRDC reactor. This proposal has been accepted as the basis for negotiation of a contract between PRDC and the AEC under the Power Demonstration Reactor Program. An outline of such proposed research and development work, as it has been tentatively accepted by both parties as a basis for further negotiation, is contained in Exhibit XX to the PRDC Application for License.

From its contractual relationship with Atomic Power Development Associates, Inc. (APDA), PRDC already has available to it the resources of a research and development program in this field which has been under way for some five years, with particular emphasis on the design and materials phases of the fast reactor program.

If this contract is executed, therefore, PRDC, as well as any other interested groups, will have available to them the results of this specific research and experimentation to be conducted by the Commission substantially as described in Application Exhibit XX. In addition, it will, of course, have available the extensive work in connection with the PRDC [fol. 4118] reactor to be done by APDA and organizations with which APDA has contracted. I am generally familiar with this APDA research program, since data so developed in connection with the PRDC reactor has been available to the Commission under a study agreement for about the last five years.

In my opinion, the programs to which I have referred in my testimony should make available the remaining technical information needed to determine definitively whether or not the PRDC reactor can be operated at its proposed Lagoona Beach site without undue risk to the public health and safety, and that, as indicated by the schedule I have

already outlined, sufficient information for this purpose should become available by the end of 1959, when construction of the PRDC reactor is scheduled to be completed. I am further of the opinion that the results of these programs will show either that the proposed PRDC reactor as now designed can be safely operated, or that design changes can be effected which will satisfy the necessary public safety standards.

[fol. 4119] EXHIBIT 1

COMPARISON OF FAST REACTORS

	EBR-I	*EBR-II*	*PRDC*
POWER			
Thermal Mw	1.4	62.5	300x
Electrical Mw	0.2	20	100
Thermal Efficiency %	17	32	30
Max. Ht. Flux	209,000	1,100,000	1,095,000
Avg. Ht. Flux		750,000	765,000
Avg. Specific Power Kw/Kg	18.1	300	670
Avg. Power Density Kw/L		1000	820
FUEL AND MATERIALS			
Crit. Mass Kg	52	210	450
% Enrichment	90	60	25
Amount of U-238, Tons	4	50	—
COOLANT AND STEAM DATA			
Na or NaK Inlet °F (Primary)	440	720	550
Na or NaK Outlet °F (Primary)	600	900	800
Na or NaK Inlet °F (Secondary)	420	580	500
Na or NaK Outlet °F (Secondary)	580	880	750
Steam pressure psig	400	1250	600
Steam temperature °F	527	850	720
NEUTRONICS			
Avg. Flux N/ cm 2/ sec	2.0×10^{14}	2×10^{15}	5×10^{15}
Avg. Core Energy, mev.	0.5	0.2	0.2

[fol. 4326] In evidence June 17, 1957, Tr. 3222

BEFORE THE ATOMIC ENERGY COMMISSION

Docket No. F-16

In the Matter of

POWER REACTOR DEVELOPMENT COMPANY

TESTIMONY OF ABEL WOLMAN
PROFESSOR OF SANITARY ENGINEERING
THE JOHNS HOPKINS UNIVERSITY

Background and Qualifications

My name is Abel Wolman. I am Professor of Sanitary Engineering at The Johns Hopkins University, Baltimore, Maryland.

I was born in Baltimore, Maryland, on June 10, 1892. I received the degrees of Bachelor of Arts in 1913 and Bachelor of Science in Engineering in 1915, and the honorary degree of Doctor of Engineering in 1937, all from The Johns Hopkins University.

I have been engaged since 1915 in the practice and teaching of the profession of Sanitary Engineering. During that period I have held the following public offices, among others, in the State of Maryland between the dates indicated:

Chief Engineer, Maryland State Department of Health, 1922-1939

Chairman, Water Resources Commission of Maryland, 1933-1940

Chairman, Maryland State Planning Commission, 1934-1945

I have served on numerous national and international committees in the field of Sanitary Engineering, including the following:

Chairman, Advisory Committee on Sanitary Engineering and Environment, Division of Medical Sciences, National Research Council, 1942 to date.

Chairman, Expert Committee on Environmental Sanitation, World Health Organization, 1949-1952.

[fol. 4327] Chairman, Permanent Sanitary Engineering Committee, Pan American Sanitary Bureau, 1942 to date.

Federal Member, Potomac River Commission, 1940-1950.

I have at various times served as a consultant to the U. S. Public Health Service, the Tennessee Valley Authority, the War Production Board, the U. S. Navy Department, the Surgeon General, the Department of the Air Force, the National Science Foundation, the Defense Department, numerous American cities and local government bodies, the Governments of the United Kingdom, Israel, Ceylon and Argentina, and a number of business enterprises. I am a Past President of the American Public Health Association and the American Water Works Association and a Past Editor of the American Journal of Public Health and the Journal of the American Water Works Association. I have been Professor of Sanitary Engineering at The Johns Hopkins University since 1937.

I have served as consultant to the Atomic Energy Commission on general wastes problems and particularly as Chairman until 1957 of its Stack Gas Working Group. I was a scientific advisor to the United States Delegation, International Conference on Peaceful Uses of Atomic Energy. I have served since 1947 as a member of the Reactor Safety Committee and the Advisory Committee on Reactor Safeguards.

I am generally familiar with the nature of the proposed PRDC reactor and the major safety problems associated with it, although I have not attempted to review in detail all of the technical information relating to the design of the reactor or to particular safety problems. While I did not attend the meeting of the Advisory Committee on Reactor Safeguards on June 3, 1956, I am familiar with the letter from Dr. McCullough to Mr. Fields of June 6, 1956,

and the recommendations of the Advisory Committee set [fol. 4328] forth in that letter. I have reviewed APDA-114, such portions of APDA-108 and Amendment VIII to the License Application as appeared to me to be relevant to environmental problems, the written testimony of Messrs. Bethe, Hilberry and Amorosi and such portions of their oral testimony as appeared to be relevant to environmental problems, the testimony of Dr. McCullough and Mr. Rogers, and the written testimony of Dr. Brooks.

The Function and Method of Approach of Sanitary Engineering

The sanitary engineer concerns himself with the impact of the environment upon the health and welfare of man. His functions historically extend over the adjustment of those features of the environment which may produce disease, nuisance or discomfort. In general, such areas of action relate to water supply, sewerage, milk and other foods, atmospheric pollution, industrial wastes, industrial hygiene, community refuse, etc.

The sanitary engineering discipline, therefore, requires a hybrid scientific underpinning consisting essentially of engineering training (in general, civil engineering) coupled with biological, chemical and physical sciences. The tools are composed of these combinations of the engineering arts and the basic sciences of biochemistry and biophysics.

In application, the sanitary engineer is dependent upon the industrial designer and operator for the disclosure of process, hazard to on-site personnel and surrounding public, nature and quantity of wastes and their relationship to the site as a whole. The sanitary engineer evaluates and appraises the impact on the surroundings of the industrial operations. In the handling of industrial wastes problems, for example, the sanitary engineer had to acquire a sufficient understanding of specific industrial processes [fol. 4329] to assess the origin, composition, volume and behavior of the resultant wastes. Since such wastes ultimately are returned to nature, via the air, the soil and the water, a large body of knowledge has been accumulated as to the behavior of such materials under the varying

natural conditions. Most of the orthodox industrial processes have become, in the course of time, sufficiently familiar to the sanitary engineer to permit him to make realistic appraisals of waste products and site problems. This does not mean that every sanitary engineer is a master of every industrial process, old or new. He is, however, either by personal experience or by literature search, provided with a reasonably detailed understanding of industrial processes, with particular reference to the behavior and the toxicity to humans and lower animals of any materials which may be released to the environment. Many quantitative criteria to aid in such judgments have been developed both theoretically and empirically.

The nuclear fission industry, new as it is, poses no strange or esoteric problems of site evaluation or of waste products management. The criteria as to toxicity and as to permissible limits for health and safety are new and still in evolution, but the principles and practices by which such criteria are applied to site evaluation and waste management are old and familiar.

General Criteria for Evaluation of a Site for Power Reactor

Site evaluation for any industrial facility requires, first, knowledge of the nature of the proposed facility and the kinds and quantities of possibly harmful materials which could be released from it both under normal operation [fol. 4330] and by an accident; and second, an understanding of the physical environment of the site insofar as that environment may have a bearing on the possible injurious effects to persons and property of any such release.

The basic criteria for evaluation of a site for a power reactor differ in no essential principles from those for the evaluation of a site for any other kind of industrial facility. A nuclear reactor has, however, special qualities, even when it can be classified as essentially stable and reliable in character. Its essential difference from other industrial facilities lies in the fact that even under normal operation a power reactor accumulates fission products in relatively large volume. These products are potentially more danger-

ous and more toxic than any other products known to industry. Indeed, Dr. McCullough has pointed out that fission products are more toxic per unit weight than any other industrially known materials by a factor of a million to a billion.

Under normal operation adequate provision must be made for the shielding of personnel from radiation released by these fission products and for the continuous or periodic safe withdrawal and disposal of these products. If an accident should occur, these accumulated products may be spread in one form or another within the operating area or, in some unfortunate instances, to areas very considerably beyond the confines of that area.

In site evaluation for a power reactor, therefore, four principal issues must be considered in the same manner as they would be considered in the case of any more familiar industrial hazard. They are:

(1) The types and quantities of release of harmful products that can occur from normal operation.

[fol. 4331] (2) The types of accidents that might occur and the probability of their occurrence.

(3) The nature and extent of property damage and personal injury that could result from either of the foregoing.

(4) The positive benefits to society, from the development of nuclear power, which must be balanced against these risks.

The Possible Hazards of a Reactor Accident

While careful attention must be given to the possible releases of toxic material from normal operation, the principal hazard with which one must be concerned at this stage of the development of nuclear power reactors is the possibility of a major reactor accident. This possibility, and the magnitude of its possible consequences, have been discussed in general terms in the excellent theoretical analysis, submitted by the Atomic Energy Commission to the Congressional Joint Committee on Atomic Energy on March 22, 1957, entitled "Theoretical Possibilities and Con-

sequences of Major Accidents in Large Nuclear Power Plants," and sometimes referred to as the "Brookhaven Report." In forwarding this report, the Acting Chairman of the Atomic Energy Commission stated:

> "The report serves to identify areas where continued research and development are needed, and areas where emphasis is needed in the further development of our regulatory program. It gives renewed emphasis to our belief that our research and development program in the nuclear power field must continue with vigor to the end that the 'conceivable' catastrophe shall never happen."

While I wholly agree with the necessity for doing everything possible to insure that a release of fission products outside the reactor site cannot occur, I do not believe that this report disposes in any way of the continuing necessity for careful analysis of the problems of site selection and [fol. 4332] evaluation for power reactors. As other witnesses have pointed out, the possible consequences of a bad reactor accident are so grave that one must rely on the cumulative safeguards of a series of protective barriers. One of the important protective barriers, in my judgment, is selection of a site such that, if other barriers fail, the adverse consequences of a release of fission products into the environment will be minimized. The importance of such siting considerations is of course heightened to the extent that the reliability of the instrument itself is subject to unresolved uncertainties.

It is undoubtedly true, as the Brookhaven Report points out, that major catastrophic reactor accidents are highly unlikely. The fact remains, however, that highly unlikely accidents have occurred in other industries. Familiar examples are the Texas City disaster on April 16, 1947, which resulted in over 570 lives lost, some 3500 injured, and property damage claims exceeding $50,000,000, and the Livonia fire at General Motors in 1953, which caused complete destruction of buildings and equipment at a loss of $50,000,000 and 2 deaths. The South Amboy, New Jersey, explosions of May 1950 illustrate a juxtaposition of im-

probable events. As a matter of fact, the events which resulted in multiple explosions of adjacent plants, panic, high destruction of property, but fortunately little loss of life—might be considered a major comedy of errors of site selection, of fire fighting, etc. The significance of each of these incidents is that they did occur. Indeed, the conviction which grows upon me as the result of many years' consideration of problems of industrial hazards is that highly unlikely things do occur.

[fol. 4333] Serious accidents, whether industrial or disease epidemic, are often the result of a series of unexpected concomitant events—all in total of great improbability.

Comparison of the probabilities of such accidents as these with the theoretical probabilities of major accidents from nuclear power reactors is difficult if not impossible. In the nuclear field there has been a greater concern with safety than in any other industrial field; the attempt is to analyse and guard against possible accidents in advance and to provide multiple protective devices designed to fail safe. On the other hand, the nuclear technology has developed more rapidly than in almost any other industrial field and hence our operating experience with nuclear facilities, materials and phenomena is relatively small.

At the very least, there is no reason to suppose that the power reactor industry, unlike other industries, will be immune from major accidents. The fact that no lives have thus far been lost from operating reactors, while gratifying, rests upon too brief a period of experience to warrant any assurance that this state of affairs will continue. The fact is that accidents to nuclear facilities have not been rare. All that one can say is that the consequences of such accidents have not been serious in the sense that no lives have been lost, that the damages, although some times extensive, have been restricted to dollars, and that the sites of most such accidents have been relatively isolated from dense population centers.

The best known example is an accident to the NRX reactor at Chalk River, Ontario, which occurred on December 12, 1952, as the combined result of operators' errors, malfunction of equipment, and certain features of the

[fol. 4334] reactor itself. The accident melted and ruptured a number of fuel elements and caused radioactive water to leak out of the reactor; it did not result in any major release of fission products directly to the atmosphere. The dollar damages were great, over a year was lost in returning to operation, and the disposal of highly radioactive wastes—amounting to over a million gallons containing some ten thousand curies of long-life fission products—was and continues to be a major problem. The accident occurred shortly after the start of operations and hence at a time when the accumulation of fission products was at a minimum. It also occurred at an extremely isolated site. It would be most interesting to speculate how these quantities of waste material, or indeed the greater amounts of activity which could have occurred after a substantial period of operation, could be disposed of on a site near population centers. It is obvious that the cleanup problems following even such a non-violent accident could have very serious consequences on the safety of surrounding populations unless adequate facilities were available to dispose of large quantities of radioactive wastes.

A number of other accidents and incidents to nuclear facilities are collected in a publication of the Atomic Energy Commission entitled "A Summary of Accidents and Incidents Involving Radiation in Atomic Energy Activities," June 1945 through December 1955, TID-5360.

Reference has already been made in the testimony to the meltdown of EBR-I, the rupture of a fuel element in Clementine, and the destruction of Godiva.

The foregoing comments indicate that there remains an unfortunate gap between the mathematical predictability of accidents and their actual occurrence. This gap exists even in so-called conventional industries; it is presumably [fol. 4335] even greater in a novel industry whose technology and materials are not yet fully understood.

In recognition of this gap, it was for some time the policy of the Government to locate nuclear reactors at isolated sites. Beginning with the sodium intermediate reactor at West Milton, New York, it has become the practice in a number of instances, in recognition of the practical desir-

ability of a more accessible location, to rely for protection on a metal envelope as a substitute for distance. In my view such containment should be considered not as a substitute for the inherent safety of a reactor, but as merely an added factor of safety. Some may feel that any foreseeable reactor, once enclosed, should be and can be put anywhere in populated areas. My own judgment is against such a principle in the present state of understanding of the science and art of reactor design and operation. A container must provide for multiple openings. It must permit entrance and exit by operating, maintenance and technical workers. It must provide openings for utility servicing pipes, coolant systems, electrical connections, and the like. For example, Mr. Amorosi has testified, at page 2631 of the Transcript, that there are perhaps twenty large penetrations and several thousand small penetrations contemplated for the containment shell of the proposed PRDC reactor. Each perforation of the container, no matter how well-done, creates opportunity for structural weakness, for unexpected opening, and for ultimate careless failures to close exits. Since personnel will be working inside the containers, some of these openings will presumably be opened and closed several times a day. Even though airlocks with double doors are provided, such locks do not provide absolute protection. Indeed, in underwater tunnelling fatalities have occurred because such airlocks [fol. 4336] were left open or failed. Should such an airlock happen to be open at a time when a serious reactor accident occurred, the protective value of the container could be seriously reduced or wiped out.

The Princeton Laboratory fire of only a few years ago is suggestive in this connection. A review of this fire disclosed an unfortunate series of failures of so-called safety mechanisms, some of them fantastically foolish in retrospect. The burning out of an electrical wiring installation early in the Princeton fire made quite worthless fire safety doors which could not be operated manually and therefore could not isolate a relatively small fire within a single room. The building was destroyed by the fire.

Proper containment is an important additional safeguard against the dispersion of toxic materials in case of an

accident. With proper design and operating procedures the chance of a failure of the containment structure can be minimized, but it cannot be wholly eliminated. In my judgment, therefore, containment is not a substitute for either a safe mechanism or a suitable site and should be used only in conjunction with a realistic appraisal of both the instrument to be enclosed and the location at which it is to be placed.

Looking at the questions of reactor hazards from my point of view as a sanitary engineer, the considerations which I have discussed above all serve to emphasize the importance of an adequate site evaluation. There must be a competent and thorough appraisal of the environmental hazards which might be occasioned either by normal operation or by an unexpected accident. The environmental conditions which should be reviewed include the geology, the hydrology, the meteorology, and the population distri- [fol. 4337] bution in relation to the specific site or sites under consideration. In similar fashion, the community conditions surrounding the site must be reviewed with particular reference to the downstream users of ground and surface waters and the proximity of industrial and residential installations, agricultural activities, and recreational areas. Their distance, their nature, and the possibility of interference with their use become issues in appraisal. Review must be made of the characteristics of gaseous, liquid and solid wastes which can result from both normal operation and accidental conditions; their quantity and quality must be considered, the treatment facilities to be provided, the adequacy of storage and the nature of ultimate disposal facilities must be reviewed, all from the point of view of assuring that adequate means are available to prevent a release of toxic materials to the surrounding environment. Since considerable use is made of nature itself in the evaluation of dilution or concentration factors, careful investigation must be made of all natural features which will tend to dissipate or increase the hazards.

It would resolve a great many difficulties and debates if all of the elements which go into the appraisal of a site could be translated into a simple mathematical formula.

Unfortunately, this is not possible. The number of parameters involved in such a formula is great and they do not lend themselves to mathematical statement or accuracy. Continuing efforts have been made to adapt these qualitative appraisals or judgments to a mathematical formula. Generally, these formulae have sought to express desirable exclusion distances as a function of magnitude of power to be developed. Both the validity and usefulness of such formulae appear doubtful. It is probable that site selection for power reactors will continue for many years to [fol. 4338] come to be a field for detailed appraisal by qualitative judgments, tempered by experience, accident occurrence, and philosophy of regulation. To permit such an appraisal, the most complete information should be available for any site which is to be considered for a reactor of significant power. Estimates must accurately be made not only of the probability of accident, but of the measures which would be taken to avoid risks to employees and to offsite populations in managing the consequences of such an accident.

In general, it is apt to be true that the proponents of a particular reactor show the highest degree of optimism regarding both the machine and its site, while those most directly concerned with the protection of the health and safety of the public demonstrate a less degree of optimism. This juxtaposition of judgments is neither unfamiliar nor unexpected. Historically, it accounts for the fact that site locations for industries of more familiar and normal characteristics usually have external review by public regulatory agencies. This situation has arisen not so much because of any philosophical difference of opinion, but because experience has shown that industry is not always the best judge of the disability which it might create for the public. Examples of invalid assumptions in this respect by conventional industries could be listed by the dozens.

Environmental Problems of the Location of the PRDC Reactor

In applying the general principles discussed above to evaluation of the environmental problems presented by the

PRDC reactor and its proposed site, one must start with an evaluation of the accident hazards presented by the PRDC reactor itself. I do not, of course, purport to be [fol. 4339] expert on the questions of nuclear physics and engineering which are predominant in a determination of these accident potentials. From such portions of the License Application and the record in this case as I have read, however, it would appear that the safety and reliability of the reactor are not yet established, but remain to be established by additional research and development work to be performed prior to the commencement of its operation. If that work establishes that the reactor is inherently safe and reliable, and that no credible accident can release fission products into the atmosphere, then the proposed site would be satisfactory from the point of view of its accident potentiality. This, however, could only be determined on the basis of a more definitive analysis of the hazards potential of the reactor than I have yet seen. If, on the other hand, the research and development work is such as to leave substantial remaining doubts as to the safety and reliability of the reactor, and the possibility that an accident could release fission products into the atmosphere, then the suitability of a location in a populous area and within 30 miles of two major cities is open to very serious question.

As I have stated, in reaching a judgment on siting, I must rely on the judgments expressed by nuclear physicists and nuclear engineers to determine the accident potential of the machine. From the testimony of Hilberry, Bethe, McCullough, Rogers, and Brooks, it is quite apparent to me that there exists as of the present date a disagreement among the experts concerning the safety of the type of reactor proposed by PRDC. On the one hand, Hilberry and Bethe seem satisfied based on present experimental information and certain theoretical calculations. On the other hand, both Rogers and McCullough have stated ex- [fol. 4340] plicitly that they still agree with the conclusions set forth in the June 6, 1956, letter signed by Dr. McCullough on behalf of the Advisory Committee on Reactor Safeguards, while Brooks states that "I do not believe

that the presently existing supporting data are sufficient to give us the kind of confidence we ought to have to permit a project of this magnitude to be operated."

In short, the present views of those qualified to have opinions on the questions of nuclear physics and nuclear engineering involved cover a fairly wide spectrum, ranging from fairly complete assurance of safety to serious doubts which cannot be resolved for several years. Faced with such a divergence of views I, as a sanitary engineer engaged in evaluating a site, can only conclude that the suitability of the proposed site has not been established. In particular, I cannot, in evaluating the site, accept only the optimistic views of Bethe and Hilberry and disregard the views of other competent men who believe that the inherent safety of this type of machine has not been and probably cannot for some time be, established.

Unless and until the inherent safety of the reactor, and the ability of its various structures to contain a serious accident, are established to the satisfaction of most of the people competent in these areas, it is evident that very serious questions are presented from the point of view of sanitary engineering as to the suitability for such a reactor of the proposed site, or indeed any site in relatively close proximity to large centers of population. These questions may, of course, become resolved by the results of work yet to be done, but this does not alter my conclusion based on the present state of knowledge.

In addition to these unresolved questions of accident potential, there is also a serious question as to the capacity of the proposed site to handle the problems of waste [fol. 4341] disposal which could arise in the event of a serious contained accident. Mr. Amorosi has testified that "very little study to date" has been made of the problem of cleanup of a major incident. (Transcript p. 2590; see also p. 2592.) Hence, it is impossible for me to say at the present time whether it will be possible at the proposed site, by provision of adequate facilities and procedures, to deal adequately with the cleanup problems which could arise, or whether there may be features of the site which seriously increase the possible public hazards attendant on such cleanup.

In this connection, I point out that the tenor of Mr. Amorosi's testimony, as I understand it, is that it is not necessary at this time to have developed the procedures and methods of handling the wastes which might result from a contained accident because he feels confident that it will be possible safely to put those wastes into containers and transport them off site. In my judgment, the quantities of radioactive materials which could result from a serious contained accident are sufficiently large and the hazards attendant upon release to the environment of even a part of those materials sufficiently great so that one cannot be sure that adequate means of disposal of those wastes at the proposed site will be available unless the problem has been carefully studied. When there is a contained accident, one can do any of several things. One can shut the facility down and permit the fission products to remain inside for an indefinite period. In this event there are risks of leakage or seepage through the container, the structures, and the soil which would have to be analysed; the extent and seriousness of these risks may be dependent in part on meteorology, hydrology and ground seepage. [fol. 4342] Alternatively, one can remove the material into on-site disposal facilities; here again, the meteorology, hydrology and soil conditions are highly important. Finally, one can enclose the material in containers and transport it off-site to a safe storage area. The transportation of large quantities of radioactive wastes through a populous area involves other hazards of a possibly serious nature. Moreover, some or all of these courses of action may entail costs which are so great as to approach being prohibitive. Until the problem has been studied and general plans for the handling of contamination resulting from a contained accident have been developed, I do not feel that I am in a position to form any conclusion as to the practicability of dealing with such problems at the proposed site.

The environmental information which has been submitted in connection with this application, and which I have attempted to review in detail, does not afford an adequate basis for an evaluation of the particular site. The information is contained primarily in the monograph entitled APDA-114. This document may be fairly classified as a

purely introductory evaluation of environmental problems created by this site. It leaves unanswered a variety of questions upon which any decision as to the validity of the site could be made. It is studded with recommendations for future very much more detailed studies. In virtually no instance do the authors of the various portions of the document attempt to give their conclusions even the semblance of definitiveness.

For example, it appears that surrounding densities of population have been analysed only for a ten-mile radius (Appendix VII, p. 2). The meteorological studies (Appendix IV), although described as a final report, state that they are "hampered by the absence of knowledge of [fol. 4343] the diffusion pattern over and near a lake surface" (p. 29), and recommend a program of meteorological observations at or near the plant site, and of studies of diffusion over the lake under various meteorological conditions (p. 20). The results of neither of these are available. Mr. Amorosi's testimony indicates that a steel tower has been erected at the plant site and that observations are being taken from it but have not been analysed, while the diffusion studies have not commenced (Tr. 2584). Information as to quantities of radioactive wastes from normal operation is not yet available (Tr. 2587), and very little study has been made to date about the problems of cleanup of a major incident (Tr. 2590-92). Apparently little or no study has been given to problems of site inundation. Studies of the possibility that the lake level might exceed presently recorded high water marks are incomplete (Tr. 2583). Water and air samples are still to be obtained (Tr. 2580). I find little or no discussion of the effect of an accident at the site upon water intakes north and south of the site area. Information on sources of potable and industrial water supply is still to be furnished (Tr. 2582). In general, the testimony indicates that essentially the only area of environmental information which even Applicant regards as complete is the seismological data (Tr. 2597).

Such information as has been submitted discloses the following specific problems with respect to the proposed

site, which in my judgment would have to be resolved before a determination could be made as to the suitability of the site for a power reactor whose stability and basic safety had been established:

(a) The meteorology of the site is quite complex because of its proximity to the lake. The high frequency of fogs of long duration at certain seasons of the year, other natural manifestations of inversions and highly erratic air [fol. 4344] currents are commented upon in APDA-114. Their detailed identification still remains undocumented, and in particular there is inadequate discussion of the behavior of gaseous and fine particle releases into the air. In my judgment, probably few sites in this region would pose as many meteorological issues as the one here chosen.

(b) Since, as I understand it, chemical processing of fuel will not be carried out at this site, there is a natural concern as to the manner in which spent fuel elements will be transported off-site and any possible hazards attendant upon such transportation. I have seen no discussion of this problem in the evidence.

(c) The location of municipal and industrial water intakes with respect to the site has not been fully indicated. The effect of discharges (by accident or by intent) upon such intakes should be evaluated, with particular reference to water currents, wind action, etc.

(d) Additional study appears necessary of the possibility of flooding of the site and the extent to which such flooding could result in premature dispersal of radioactive wastes in the hold-up tanks or lagoons.

Based on the information available, it is my judgment that with adequate containment and assuming the construction of adequate facilities and adoption of adequate procedures for the disposal of normal operating wastes, surrounding populations and properties would probably not be endangered by normal operation. The information submitted affords an inadequate basis, however, upon which to rest any evaluation as to the environmental hazards which would be presented either by severe floods under normal reactor operation or by the cleanup of a contained

[fol. 4345] accident. Finally, neither the technical nor the environmental information affords an adequate basis for the evaluation of the hazards to the environment which would be created by an uncontained accident. In my judgment, therefore, any definitive determination with respect to the suitability of the proposed site for the proposed reactor cannot be made until substantial additional information has been supplied.

[fol. 369] Cross-examination of Ernest R. Acker by Mr. Sigal; Attorney for Intervenors, on March 4 and March 5, 1957, Tr. 369-70, 372-73, 467.

* * * * * * *

Q. In the light of the fact that PRDC says it will not under any circumstances operate this reactor unless it is safe, why wouldn't $65 million be adequate coverage?

A. Mr. Sigal, I assume if you were advising a client, even if they had what they considered to be and maybe what you considered to be a completely safe operation, which we think we can ultimately achieve, I think you as a lawyer would advise them to take whatever insurance they could get or whatever they felt was necessary to meet the remotest ultimate risk and that is our philosophy with respect to insurance.

Q. Insurance is not based on the determination of what the remotest risk is, Mr. Acker. Isn't it based on what experience shows to be the risk in given situations?

A. I would say that the rates are based on the experience with respect to various classes of risk, yes. But I don't know of any experience background on which that could be determined in this case.

Q. So in this situation all those who are connected with this problem are unable to put any limit on the possible liability that may flow from the operation of a reactor? Is that correct?

A. I don't know as to that, Mr. Sigal. I am not willing to admit that freely.

Q. PRDC takes the position that is it not possible now to put any top figure less than $500 million on the possible

liability arising from the operation of this plant, is that right?

A. I would say that is a fair statement.

* * * * * * *

Q. Mr. Acker, you stated in your testimony on direct examination earlier that the companies which are members of PRDC have assets of over $6 billion and an equity of over $2 billion.

A. That is right.

Q. Why wouldn't those companies underwrite the risk in operation of this plant if the risk is no more than $500 million?

A. I think for the very same reason that very few companies are self-insurers.

[fol. 370] Q. If you can't get insurance from private companies, then you would be obliged to do self-insurance.

A. We would have to consider whether we wished to risk the assets of our stockholders to provide for that kind of contingency.

Q. You have not considered that so far?

A. No.

* * * * * * *

Q. As a matter of fact, I assume you know, Mr. Acker, that no fast breeder reactor has been built which has survived all tests made?

A. I think that is a fact.

* * * * * * *

[fol. 4858]

COMMISSION EXHIBIT No. 3

(The letter of transmittal accompanying the following Report is printed at pp. 349-356 of Volume II of the Record.)

United States
Atomic Energy Commission

THEORETICAL POSSIBILITIES AND CONSEQUENCES OF MAJOR ACCIDENTS IN LARGE NUCLEAR POWER PLANTS

A Study of Possible Consequences if Certain Assumed Accidents, Theoretically Possible but Highly Improbable, Were to Occur in Large Nuclear Power Plants

March, 1957

[fol. 4859]

United States
Atomic Energy Commission

This report to the Commission contains an account of a study undertaken by the Division of Civilian Application, at the direction of the General Manager, to gain a more comprehensive understanding of the potential public hazards of nuclear power reactors.

All technical phases of the project were performed by a study team composed of staff members of the Brookhaven National Laboratory, with assistance of consultants and others from elsewhere. Principal contributors were:

Dr. Clifford K. Beck
Dr. Frederick P. Cowan
Mr. Kenneth W. Downes, Project Director
Dr. Joseph A. Fleck, Jr.
Dr. J. B. H. Kuper
Mr. James McLaughlin
Mr. Irving Singer
Mr. Maynard Smith

The study was carried out under the guidance of a Steering Committee composed of scientists and engineers of the

Atomic Energy Commission staff and the Brookhaven National Laboratory. Members were:

Dr. Clifford K. Beck, AEC, Chairman, Steering Committee
Dr. Walter D. Claus, AEC
Mr. Kenneth W. Downes, BNL
Mr. Merrill Eisenbud, NYOO
Dr. Clark Goodman (replaced by Mr. Howard Hembree, AEC)
Mr. Edwin A. Lamke, AEC, Secretary
Dr. Gerald Tape, BNL
Dr. Clarke Williams, BNL

Valuable assistance throughout the study was also rendered by Mr. Joshua Z. Holland, AEC, and in some of the technical phases by Mr. Raymond O. Brittan, Argonne National Laboratory, and Mr. Everitt P. Blizard, Oak Ridge National Laboratory.

Many other staff members, consultants and advisers, including members of the Advisory Committee on Reactor Safeguards also rendered valuable assistance in the study.

[fol. 4860]. Table of Contents

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Appendix F A Method for Calculating the Number of People That Could Be Affected by a Fission Product Release

Appendix G Basic Assumptions in Calculating Potential Losses

Appendix H Consequences of Gamma Radiation From a 100 Percent Release of the Fission Products into the Containment Shell

Appendix I Personal and Property Damage Resulting from Release of Fission Products from a 500,000 Kw (Thermal) Reactor

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[fol. 4861] INTRODUCTION

[fol. 4862] INTRODUCTION

It might be supposed, because the essential fuel in a nuclear power reactor is the same as that in atomic bombs, that gross malfunctioning in power reactors could possibly lead to a devastating explosion similar to those produced by A-bombs. Such is not the case. Under no conceivable circumstances can accidental nuclear explosions in power reactors cause significant direct public damage beyond the boundaries of the exclusion areas around such installations.

There could be explosive nuclear energy releases in power reactors, or chemical or physical energy releases from components or auxiliary systems, sufficient in magnitude to destroy the reactor, possibly break the various containment structures within which it is housed and wreck the auxiliary machinery. Such an accident would constitute a real threat to the life of personnel within the facility and could result in complete loss of the expensive installation. Nevertheless, little hazard to the general public would ensue from the explosion itself.

There is, however, another hazard to the general public which could cause extensive loss of life and damage to property. This is the possibility of radiation exposure and [fol. 4863] contamination, if the fission products stored up in the reactor should be released. It is possible to conceive of accidents which would release the accumulated fission products from a large nuclear reactor in a finely divided state so that a significant portion of them would become airborne and subject to atmospheric dispersal over wide areas. Injury or death could result to people from exposure to the direct radiation from these materials, or from ingestion of portions into the body. Settling out of these materials could cause both further hazard to health and costly contamination damage to property. Death at distances of many miles and injury and property damage for hundreds of miles could conceivably occur.

Fortunately, radiation intensity from most fission products released from a reactor decreases rapidly. The possibility of total release is exceedingly remote, and among those products most likely to be released are those which decay most rapidly. In no conceivable way could fission products from a reactor be distributed rapidly and uniformly over large areas. The major threat to the safety of people remote from the site of release would not be instantaneous; periods up to hours and even days after release would be available within which to avoid the full effects of radioactivity from the fission products.

It must be clearly recognized, however, that major releases of fission products from a nuclear power reactor conceivably could occur and that a serious threat to the health and safety of people over large areas could ensue. [fol. 4864] An over-all appraisal of the actual magnitude of hazard to the public arising from operation of a nuclear power reactor revolves around the best possible answers to four essential and difficult questions:

1. What is the likelihood that fission products might be released?
2. What are the factors and conditions which would affect the distribution of released materials over public areas?

3. What are the levels of exposure or contamination which cause injury to people or damage to property?

4. If releases of fission products should occur, what deaths or injuries to people and costs in damaged property could ensue?

Succeeding sections of this report are devoted to consideration of these questions.

It is important to recognize that the magnitudes of many of the crucial factors in this study are not quantitatively established, either by theoretical and experimental data or adequate experience. Appraisal must rest on the judgment and considered opinions of the most knowledgeable persons in the field. At various places in the report note will be made where important components are particularly uncertain, but it must be remembered continuously that this entire study hardly constitutes more than an identification of the factors which are important, the best appraisal of these [fol. 4865] factors currently possible, and a rough approximation of the magnitudes of the composite results.

There are many essential and significant qualifications and uncertainties in the conclusions contained in this report. If separated from these qualifications and uncertainties, the conclusions would lose their validity. However, we believe that the study, if taken in perspective, gives an order-of-magnitude frame of reference, and defines tentative boundaries for this problem.

More definitive information on estimated factors would probably tend to reduce the estimates of damages, though in a few instances the converse might be true. There are a few less usual weather conditions which occur perhaps 5 percent of the time and which could yield estimated damages outside the range of the figures stated here. Therefore, this study does not set an upper limit for the potential damages; there is no known way at present to do this. It does indicate the range of hazards from highly improbable catastrophic reactor accidents which might occur under all except a small percentage of most unusual combinations of circumstances.

[fol. 4866] PART 1

THE PROBABILITY OF CATASTROPHIC REACTOR ACCIDENTS

THE PROBABILITY OF CATASTROPHIC REACTOR ACCIDENTS

[fol. 4867]

The probability of occurrence of publicly hazardous accidents in nuclear power reactor plants is exceedingly low.

This single statement, re-emphasized, would suffice to report this portion of the study, except for the essential importance of this central fact of "low probability" to comprehension of the over-all public hazard of power reactors. The significance of damages consequent to accidents cannot be appraised independently of the probability of the accidents.

One fact must be stated at the outset: no one knows now or will ever know the exact magnitude of this low probability of a publicly hazardous reactor accident. In trying to establish some estimation of this quantity, three possible approaches might be used:

1. Operate enough reactors for sufficient length of time to obtain an indication of the accident probability.
2. Give careful consideration and approximate numerical values to all separate factors which would either prevent or cause such an accident, then try to calculate, or guess, the composite result of these factors and hence the likelihood of occurrence of accidents.

[fol. 4868] 3. Obtain a weighted average of the best judgments and judicious opinions of the most experienced and knowledgeable experts in the field.

None of these approaches is satisfactory. Even when combined, they are at the present time, still unsatisfactory.

Indications from Cumulative Experience to Date

Nuclear reactors have been operated since December 2, 1942, with a remarkable safety record. We have accumu-

lated more than 100 reactor years of experience with large routinely operated reactors without any accidents.* This record of safety, although highly reassuring, does not afford a dependable statistical basis for estimating the probability of occurrence of serious reactor accidents in the future.

In this initial period of power reactor experience, types of reactors, detailed reactor designs, and operating patterns are all experimental and variable.

There are factors both on the side which would lead toward confidence that our "accident" experience will continue, and on the converse side. On the one hand, we [fol. 4869] attempt to provide wide margins of safety because of our limited knowledge of accident potentials of reactors. The new and glamorous field challenges and attracts the most expert and competent people. The Government has had and continues to have a substantial safety research program. Experience almost certainly will lead to safer design. On the other hand, since many reactor types are being developed more varied safety problems may exist than would be the case in fewer types. Accident free experience could lead to complacency. Lengthening reactor life could lead to hazards not otherwise encountered (cumulative radiation damage to components). Competitive pressures could furnish incentives to reduce margins of safety.

Factors For and Against a Major Accident

It is very difficult to determine whether a reactor of one type is safer, overall, than one of another type. It is easy to point out superior safety features and inferior ones in any one type compared with those in another type. Safety depends on the combination of many complex and inter-related factors and overall comparison of one reactor

* All the half-dozen "runaway" incidents (Chalk River, Borax, EBR-1, etc.) experienced thus far, either inadvertent or planned, have occurred in research or experimental test reactors—in contrast to the steadily operating power reactors considered here. No one has been injured, and no fission products have been released "off-area". Hence, the accidents are not in the category of concern in this study.

type with another depends on value judgments which are difficult to define quantitatively.

To estimate the *absolute* safety of a given reactor, or of reactors in general, or to estimate the quantitative probability that an accident will occur is more difficult, and more uncertain, by several orders of magnitude, than is the relative comparison of reactors.

[fol. 4870] In principle, it should be possible to identify each factor, positive or negative, involved in the safety of a reactor, assign some measure of the magnitude of its effect and some probability of its functioning (or failing to function), then derive a net weighted composite measure of the margin of safety, or of the probability of catastrophic accident in a given time.

On the positive side would be such factors as:

1. In no reactor, so far as is known, will a single equipment failure or a single operating error lead to a fission product-releasing accident (even within the containment structure). If such condition were recognized, it would be rectified. In the vast majority of cases, multiple separate malfunctioning events are a necessary prerequisite to a serious accident.

2. Most reactors are inherently stable, e. g., most reactors possess prompt negative temperature or power coefficients (any increase in these factors is accompanied by a decrease in reactivity, hence, any excursion tends to reach some limiting value, rather than indefinitely increasing power).

3. In heterogeneous (solid fuel) reactors, the fission product inventory accumulates within the solid fuel matrix from which escape is prevented not only by low mobility of these fission products in the solid fuel but also by the metallic surface cladding. Melting or violent damage must occur before fission products can be released into the reactor vessel. In homogeneous (solution or slurry fuel) reactors, the possibility of continuous removal of the fission products offers some compensation for the lack of confinement provided within the fuel elements of other types.

[fol. 4871]

4. Every power reactor will be provided with an adequate primary containment vessel enclosing the reactor core within which fuel and fission products reside. This, in turn, is surrounded by massive radiation shields for biological protection of workers.

5. All power reactors now considered for construction in populated areas are provided with "vapor shells" designed to contain all fission products that might be released in any credible accident.

6. Seventy-five or eighty percent of the fission product elements are solids at ordinary temperatures and, unless opening of the outer vapor shell is caused or accompanied by an event which vaporizes and violently disassambles the core materials, most of the fission products would be expected to remain attached to fragments of fuel elements or to settle out on nearby structures.

7. Should fission products be released from the containment shell, not only the physical state of the materials, but also a complex variety of environmental meteorological and other factors, having various probabilities of occurrence, would govern the subsequent pattern of dispersal. Probabilities of progressively unfavorable combinations of conditions become progressively lower, so that likelihood of highly unfavorable combinations is extremely low.

On the negative side, account would have to be taken of such factors as:

1. Many power reactor systems will operate under high pressures. High pressure systems are subject to failure.

2. The cumulative effect of radiation on physical and chemical properties of materials, after long periods of time, is largely unknown. Eventual serious failures may occur.

3. Various metals used in reactors such as uranium, aluminum, zirconium, sodium and beryllium, under

certain conditions not at present clearly understood, may react explosively with water, also present in many reactors. During incidents of abnormal operation [fol. 4872] resulting perhaps in melting of some of the metals in contact with water and under the influence of radiation, chemical reactions of enough violence to rupture the containment vessels, with release of the fission products, could occur.

4. After initial operation, many of the vital components become inaccessible for inspections. In non-nuclear plants, serious accidents are often averted through detection of incipient failure.

5. Much remains to be learned about the characteristics and behavior of nuclear systems.

Listing of such items, in both positive and negative tabulations, could proceed at length. However, it should be clear already that, even if all the significant factors relevant to safety were known, it would be essentially impossible to assign dependable quantitative values to their respective probabilities of functioning and to derive therefrom a reliable indication of the margin of safety under operating conditions likely to exist.

The Best Judgment of the Most Knowledgeable Experts

Many outstanding leaders in reactor technology and associated fields were consulted in the course of this study. It is their unanimous opinion that the likelihood of a major reactor accident is low. There is a general reluctance to make quantitative estimates of how low the probability is. There is a common aversion to attachment of quantitative estimates to a phenomenon so vague and uncertain as the probability of occurrence of catastrophic accidents, particularly since such assignment of numerical estimations [fol. 4873] conveys an erroneous impression of the confidence or firmness of the knowledge constituting the basis for the estimate. Also, some hold a philosophic view that there is no such thing as a numerical value for the probability of occurrence of a catastrophic accident; that such a thing is unknowable.

Thus, many decline to make even order-of-magnitude guesses of the probability of catastrophic reactor accidents. On the other hand, a few have ventured to express their confidence of the extremely low probabilities of occurrence of such accidents by stating numerical, order-of-magnitude estimations. An indication of the range of these is illuminating.

Should some unfortunate sequence of failures lead to destruction of the reactor core with attendant release of the fission product inventory within the reactor vessel, however expensive this would be to the owners, no hazard to the safety of the public would occur unless two additional lines of defense were also breached: (1) the integrity of the reactor vessel; and, (2) the integrity of the reactor container or vapor shell.

Accidents of sufficient violence to breach the successive lines of defense occurring concurrently with progressively unfavorable combinations of dispersive weather conditions have decreasing probabilities of occurrence.

Thus, the probability of public hazards from reactor [fol. 4874] accidents may be considered in terms of a sequence of events, each being prerequisite to the situation arising from succeeding events, and each having a lower probability of occurrence than its predecessor. As indicated above, the numerical estimates ventured here represent an attempt to express in numerical terms the degree of feeling held by some of our advisers for the remoteness of the possibilities of occurrence of the various accidents described. It should be emphasized that these numbers have no demonstrable basis in fact and have no validity of application beyond a reflection of the degree of their confidence in the low likelihood of occurrence of such reactor accidents.

Their estimates for the likelihood of destruction or major damage to the reactor core with significant internal release of fission products, but no release outside the reactor vessel, ranged from one chance in 100 to one in 10,000 per year for each reactor.

Their estimates for the likelihood of accidents which would release significant amounts of fission products outside the reactor vessel but not outside the containment

building (the contained accident) ranged from one chance in 1,000 to one in 10,000 per year for each reactor.

Finally, their estimates for the likelihood of accidents which would release major amounts of fission products outside the containment (the major release accident) ranged from one chance in 100,000 to one in a billion per year for each reactor.

[fol. 4875] Taking the most pessimistic of these estimates for the major accident, assuming that 100 reactors are in operation in the United States, and making the unrealistic assumption that each accident of the type defined would kill 3,000 people, there would be one chance in 50 million per year that a person would be killed by reactor accidents. For comparison, the chance of a person in the United States being killed by automobile accidents, assuming that each person has an equal likelihood of being among the 40,000 killed, is about one in 5,000 per year.

Safety Through Safeguards

Detailed evaluation of the safety of a reactor before approval is given for its operation may not lead to any better estimations of accident probabilities than those yielded by other considerations, but it does furnish added confidence that accident probabilities are indeed exceedingly small. In fact, the confidence of many persons in the low probability of accidents is due in large part to the application of these evaluation procedures.

Three aspects of these procedures contributing to minimization of public hazards from reactor accidents are worthy of mention:

1. Knowledge that safety evaluations and reviews are prerequisite to operation approval insures attention to and emphasis on safety aspects of a facility at all stages of the design.

[fol. 4876]

2. The detailed safety analysis and evaluation by experts on the Commission staff, with assistance as necessary from consultants and advisers, including the Advisory Committee on Reactor Safeguards, assures that at

least one independent review is given to each reactor facility in addition to that given by the designers.

3. As a part of the pre-evaluation procedure, careful analysis must be given to establishment of the accident of maximum proportions considered to be credible for each reactor facility, and demonstration must be made that adequate safeguards are provided the public against this eventuality.

Thus, since there is protection against "credible" accidents, no damages to the public will occur unless "incredible" accidents take place. It must be recognized, of course, that errors in judgment can be committed, with resulting occurrence of what was believed to be an "incredible" accident. Nevertheless, the consistent and rigorous execution of these procedures for every reactor warrants a considerable degree of confidence that safeguards against serious accidents have been incorporated, and that the probabilities of such occurrences are small.

[fol. 4877] PART II

ASSUMPTIONS USED IN THE DAMAGE STUDIES

[fol. 4878] ASSUMPTIONS USED IN THE DAMAGE STUDIES

It has been concluded that there is some remote but quantitatively uncertain possibility that a major reactor accident might occur. The immediate question then follows: What could be the extent of consequent damages? The remaining sections of this report devote attention to this question. Consideration is restricted to estimation of the damages to the public. No attempt has been made to appraise the hazard or damage to the facility itself or to its personnel.

To evaluate the hazardous consequences to the public of a reactor accident of major proportions, many features must be further described relating to the size and location of the reactor, its fission product inventory and the portion released, the conditions of release and the features of its delivery to public areas. In this section of the report,

brief definitions and descriptions of those situations and features considered pertinent are recorded. Details of the technical foundations for these assumptions and specifications, and mathematical manipulations to arrive at estimates of the consequences thereof, are contained in various appendices as indicated.

Two comments are appropriate at this point. 1) Conditions and specifications described below are chosen to be representative of a "generalized" power reactor situation. [fol. 4879] Specific reactor situations will vary somewhat from the one described herein; however, use of the generalized reactor and site is adequate to permit a reasonable evaluation of general public liabilities. 2) The assumptions and specifications are chosen to be on the pessimistic side, i.e., result in higher damage estimates. This is due to an attempt to be on the safe side where uncertainties exist in present knowledge but no deliberate safety factors have been introduced.

Typical Reactor

The reactor considered is of 500,000 Kw thermal (100,000-200,000 Kw electrical) steadily operating, power producing type, having an average fuel reloading (and fission product eliminating) cycle of 180 days. Accidents assumed in this study, described later, are postulated to have occurred near the end of the 180 day cycle, when fission product inventory would be maximum. Research and test reactors and reactor experiments are excluded from consideration. A leak- and pressure-resistant containment building of the usual type is assumed to surround the reactor.

Fission Product Content of the Reactor

For the 500,000 Kw thermal reactor, 180 days of operation, the fission product inventory would be approximately 4×10^7 curies, when measured 24 hours after an accident (or shutdown). Decay of the fission products as well as their composition was taken into consideration for calculation of direct radiation exposures or contamination due to deposition. Special attention was given to the volatile [fol. 4880] fission products, xenon, krypton, bromine and

iodine and to strontium. The latter two are biologically the most hazardous.

Typical Location

The reactor is assumed to be located near a large body of water, most likely a river, and about 30 miles from a major city. As in many sites proposed to date, a site boundary of 2000 feet radius is postulated.

Population Distribution

Distributions of populations around reactors would differ considerably in detail from one site to the next. However, many general features would be remarkably similar, especially at large distances. Each reactor site would be in an area of low population density, a large city would be located about thirty miles away and the density of population would increase from the reactor toward the city. If the total population enclosed within a circle of radius R centered at the reactor, is calculated for distances to the city, it develops that the total population within given radial distances is remarkably alike for all reactor sites now in use or proposed. This population can be expressed by the equation: $P = 200R^{2.83}$, where R is in miles.

At distances beyond the city, the average population density decreases and a different expression must be used. Average population density over the entire United States [fol. 4881] is about 55 people per square mile. Reactors, however, are likely to be built in more populated areas such as in the northeast where the average runs about 500 per square mile. Therefore, the assumption is made that the population density beyond the city is constant, and averages 500 people per square mile. For most situations these assumed population distributions are on the conservative side, i.e. in hardly any likely place would the population be underestimated, and in most places they overestimate the number of persons in areas which may be affected by a reactor accident.

For some types of accidents, the high population density in the nearby city needs to be calculated independently of the general treatment described above. In these cases, it

was assumed that the city located 30 miles from the reactor has a population of about 1,000,000 persons spread uniformly over a region having a diameter of about 10 miles. Where the existence of the city contributes significantly to the calculated damages, city damages are listed separately.

Characteristics of Released Products

Accidents of greatest concern would be those which resulted in release and subsequent atmospheric dispersal of fission products from the reactor. The characteristics of the fission products at the time of release would have a great influence on their subsequent dispersal. Two factors having the greatest impact in determining the effect of distribution due to various meteorological conditions would be the size of the particles contained in the release and the [fol. 4882] temperature of the radioactive cloud at the time of release. These factors could, of course, vary from one reactor accident to another and undoubtedly would be highly dependent upon the particular accident. For the purpose of this study two choices were made for each factor, each choice being considered as probable and also illustrative of widely different conditions. For temperatures of release, the two *chosen* conditions were characterized by "hot" and "cold", the temperatures being 300°F (temperature of steam at a pressure sufficient to rupture the containment vessel) and 70°F (normal atmosphere temperature), respectively. For particle size two distributions were assumed, one centered about one micron and the other seven microns in diameter, these being representative of fumes and industrial dust, respectively. Experience does not permit a better definition of the particle size; it does, however, lend credibility to these two choices.

Mechanism of Distribution

Assuming that a release had occurred, consideration must then be given to the assumed existing weather conditions and to other factors that might influence the rate and pattern of distribution of the released materials. Numerous variables here could combine into an almost infinite variety

of situations. It is possible (see Appendix I) to obtain an indication of the range of damages from calculations on a reasonably small number of cases by limiting the number of meteorological variables to those having major influences and choosing one or two appropriate values for each.

[fol. 4883] The meteorological variables selected are: weather—(a) dry and (b) rain (.02 inches per hour over the whole area affected); atmospheric stability—(a) typical daytime lapse with a wind speed of 5 m/sec (12 mph) and (b) nighttime typical inversion with a wind speed of 3 m/sec (7 mph) up to 50 meters height and 15 m/sec (35 mph) above; height of cloud rise—(a) cold release, zero, (b) hot release, 860 meters during lapse, 400 meters during inversion. (Appendix E). It should be noted that the conditions assumed in any given case existed continuously for the duration of the case and the area affected.

It should be noted here that exceedingly little is known about the details of atmospheric distribution, even if the characteristics of the materials under consideration and the many environmental factors involved could be stated with great confidence. Nevertheless, use of these approximate average values, above, does give reasonably dependable general indications of the results to be expected in a large majority of possible situations.

Tolerance Levels for Personal Injury

Personal injury might result from exposure of personnel to the radioactive cloud released during the postulated accidents. Personal injury might also arise from exposure to deposited fission products. In the latter case, ample time often would be available to permit evacuation from contaminated areas before serious injury would occur. In appraising the hazard to individuals who might be exposed, [fol. 4884] it would be necessary to define the probable extent of injury caused by various doses of radiation. This is an exceedingly complex matter (Appendix D). Using the best advice available and considering various biological effects such as ingestion, external and internal radiation problems, and the special problems arising from particular

fission product isotopes having special biological importance, the following ranges, as described in Appendix D, were adopted:

	Equivalent Whole Body Gamma Radiation	Concentration of Released Fission Products to Give Equivalent Exposures	
		Volatile F.P.s (curie sec/m³)	Gross F.P.s (curie sec/m³)
Lethal exposure	over 450R	over 350	over 400
Injury likely	100-450R	80-350	90-400
Injury unlikely, but some expense may be incurred. Observation required	25-100R	10-80	10-90
No injury or expense	less than 25R*	less than 10	less than 10

* 25R in one exposure or 50R in three months.

The first column indicates the equivalent whole body gamma radiation adopted as the basic criterion to define the several categories. Columns two and three have been calculated for these same criteria in terms of units used to estimate the effect of passage of the radioactive cloud. While these values are believed to be the best obtainable at the present time, many of the factors used in deriving them are highly uncertain. It should be noted that personal [fol. 4885] injury is considered to have occurred only in the first two categories. Expense might be incurred for exposures in the third category, but only for examination, observation and incidentals, not actual personal injury.

Degrees of Land Contamination

By far the largest dollar cost to the public of a major reactor accident would result from contamination of land areas by deposited fission products. Inhabitants of portions of the areas affected would have to be evacuated to avoid serious exposure. Access to various areas might be denied for different lengths of time, and the subsequent use of land for agricultural purposes might be curtailed, with possible loss of standing crops. The same basic exposure-injury criteria listed above (column 1) were used also for

determining the consequences of land contamination. Details of calculations are shown in Appendix D. In the case of land contamination, the existence of specific isotopes especially strontium, must be considered very carefully. The severe restrictions that might be imposed on farming arise almost entirely from the existence of this particular isotope.

To estimate the potential loss arising from problems of land contamination both the number of persons and the area affected were calculated. In some instances the costs were evaluated by associating them with an average cost per person. In the particular cases associated with farm restriction an average cost per square mile was used.

[fol. 4886] The categories chosen, and costs assumed for each are:

Range I.	Evacuation of personnel—immediate	$ 5000/person
Range II.	Evacuation of personnel—orderly and in a reasonable time	$ 5000/person
Range III.	Restrictions on land and outdoor activity	$ 750/person
Range IV.	Crop and farm restriction	$25,000/sq. mile

The criteria used in establishing these ranges are described in Appendix D. It should again be emphasized that they are based on meager data.

REACTOR ACCIDENTS ASSUMED

Three types of reactor accidents were considered necessary for this study in order to indicate the range of public hazard which could result and to delineate the influence of the important variables as described above on the magnitude of these hazards. The three "typical" cases selected are:

A. *The Contained Case*

In this accident, it is assumed that all of the fission products from the 500,000 Kw (thermal) reactor, after 180 days of operation, are released from the core

and distributed uniformly throughout the interior of the containment building. None is assumed to escape. The fission products are assumed to decay at their natural rate, with no attempt at decontamination, etc., after the accident. Hazard to the public would arise [fol. 4887] from the direct gamma radiation from the fission products dispersed inside the containment building. One inch of steel shielding by the walls of the building is assumed. The site boundaries are 2000 feet from the reactor.

B. *The Volatile Release Case*

In this case it is assumed that all of the volatile fission products in the reactor (500,000 Kw (thermal) after 180 days), i. e., xenon, krypton, iodine, bromine and 1% of the strontium are released from the containment building and are subsequently dispersed, with characteristics and meteorological conditions as described and specified above. See Appendix A.

C. *The 50% Release Case*

In this case, it is assumed that 50% of all fission products in the reactor (500,000 Kw (thermal) after 180 days) are released from the containment building and are subsequently dispersed, with characteristics and meteorological conditions as described and specified above. See Appendix A.

Each of these arbitrary cases represents a highly pessimistic assumption. Certainly more catastrophic releases of the Contained and the Volatile types are not possible. In the third type, it is conceivable that more than 50% of all fission products could be released, but this is considered to be so far in the realm of incredibility as not to merit consideration.

[fol. 4888] PART III

ESTIMATED CONSEQUENCES OF THE ASSUMED REACTOR ACCIDENTS

[fol. 4889]

ESTIMATED CONSEQUENCES OF THE ASSUMED REACTOR ACCIDENTS

In this part of the report, there is presented a brief summary of the calculated damages obtained from each of the assumed accidents, together with brief observations and pertinent comments on the results obtained in the respective cases. Reference is made to Appendices H and I, of Part IV, for more complete tabulation of results.

Case 1—The Contained Case

The assumption is made that all of the fission products are vaporized and dispersed within the containment shell. There is no release to the atmosphere. Damage to the public would then result from direct exposure to gamma radiation. The following tabular summary shows personal injuries and evacuation costs beyond the 2000 feet boundary of he reactor site.

	Personal Injury	
	Assuming Evacuation in 2 Hours (Persons)	Assuming Evacuation in 24 Hours (Persons)
Lethal exposure	0	0
Injury likely	0	6
Injury unlikely, but expense likely	1	15

Evacuation Costs		
Number of People	Area	Cost
67	1.8 sq. mi.	$335,000

[fol. 4890] *Observations and Remarks*

1. The above results would be the maximum possible for this type of accident in that all fission products would be involved and no shielding except the container is assumed.

2. Under the best conditions, namely, prompt evacuation of nearby personnel, no personal injury would be likely. The public loss would be due entirely to evacuation costs and payments for denial of use of land. This can be measured in the hundreds of thousands of dollars.

3. Under less favorable conditions, namely, slower evacuation, a small number of personal injuries might be expected.

4. Use of the typical site and population distribution is less satisfactory for this case since nearby population variations from site to site are larger than the numbers of people affected. The method does, however, give an order-of-magnitude.

5. For smaller site boundaries, larger numbers of people would be affected, especially in the injury category. However, with proper combinations of distance and shielding no loss to the public would be involved.

Case II—The Volatile Release

Here it was assumed that, because of a breach in the container or failure to close all openings, all volatile fission products would be discharged to the atmosphere at the time of the accident. Four different situations of meteorological conditions and two particle size distributions were considered. Furthermore, separate indication is given for releases which include 1 percent of the strontium inventory and for those which do not.

A full summary of the calculated damages is contained in Appendix I. The following table contains a brief summary to indicate the magnitude and range of the consequences.

[fol. 4891] *The Volatile Release Case*

Personal Injury

A. Lethal Exposure	Persons	Conditions at Release
Minimum	2	Temperature lapse
Maximum	900	Temperature inversion, 1 μ particles

Assuming that (1) the particle size distributions are equally probable, and (2) the distribution of weather conditions is as stated in Appendix I, then lethal exposures would be less than five people for those accidents which might occur during about one-half of the time or less than 300 people for those accidents which might occur during about three-fourths of the time.

B. Injury Likely	Persons	Conditions at Release
Minimum	10	Temperature lapse, 7 μ particles
Maximum	13,000	Temperature inversion, 1 μ particles

Using the same assumptions as under A, the number of persons injured would be less than 20 people for those accidents which might occur during about one-half of the time or 2000 people for those accidents which might occur during about three-fourths of the time.

Property Damage

II. Evacuation	Persons	Area (sq. mi.)	$ Millions	Conditions
Minimum	0	—	—	Temperature lapse, dry
Maximum	41,000	28	203	Temperature inversion, rain

[fol. 4892] Under the same assumptions as under A, the number of persons requiring evacuation would be less than 1000 people for accidents which might occur during about two-thirds of the time or 6000 people for those accidents which might occur during about nine-tenths of the time.

III. General Restrictions (due to Sr)	Persons	Area (sq. mi.)	$ Millions	Conditions
Minimum	20	1	.01	Temperature lapse, dry, 1 μ
Maximum	235,000	350	177	Temperature lapse, rain, 1 μ

Under the same assumptions as under A, the area placed under general restrictions would be less than 50 sq. mi. for those accidents which might occur during about three-fourths of the time.

IV. Agricultural Restrictions (due to Sr)	Area (sq. mi.)	$ Millions.	Conditions
Minimum	3	.1	Temperature lapse, dry, 1 μ
Maximum	3,500	90.	Temperature lapse, rain, 1 μ

Under the same assumptions as under A, the area placed under agricultural restrictions would be less than 500 sq. mi. for those accidents which might occur during about nine-tenths of the time.

Observations and Remarks

1. The number of personal injuries is highly dependent upon existing weather conditions at the time of the accident. Few lethal exposures would occur during daytime conditions. Exposures of large numbers of persons would occur during temperature inversions, typical of nighttime conditions.

[fol. 4893] 2. Except when strontium accompanies the release, property damage would range from essentially no damage to cases of approximately two hundred million dollars. Without strontium, there would be no restrictions on agriculture.

3. The presence of strontium would add severe restrictions on land use both for general activity and for agricultural purposes. Decontamination would also be required within certain city areas. The net effect would be to increase the property damage and personal dislocation costs to a maximum of about 400 million dollars.

Case III—The 50 Percent Release Case

In this case it is assumed that 50 percent of all fission products would be released into the atmosphere and subsequently dispersed according to assumptions described earlier. Appendix I contains a summary of the personal injuries and property damages calculated for the variety of conditions considered. The table on the following page contains a brief summary to indicate the magnitude and range of the consequences.

[fol. 4894] *Personal Damage*

A. Lethal Exposure	Persons	Conditions at Release
Minimum	0	Hot release at any time
Maximum	3,400	Cold release, 1 μ particle size, temperature inversion

Assuming that (1) hot and cold releases are equally probable, (2) particle size distributions are also equally probable, and (3) the distribution of weather conditions is as stated in Appendix I, then lethal personal exposures would be less than 10 for accidents which might occur during about three-fourths of the time.

B. Injury Likely	Persons	Conditions at Release
Minimum	0	Hot release at any time
Maximum	43,000	Cold release, 1 μ particle size temperature inversion, dry

Using the same assumptions as under A, the number of persons injured would be less than 100 for accidents which might occur during about three-fourths of the time.

Property Damage

II. Evacuation	Persons	Area (sq. mi.)	$ Millions	Conditions
Minimum	0	0	0	Hot, temperature inversion
Maximum	460,000	760	2,300	Cold, 1 μ, temperature inversion, rain

Using the same assumptions as under A, the number of persons to be evacuated would be less than 50,000 for accidents which might occur during about three-fourths of the time.

III. General Restrictions	Persons	Area (sq. mi.)	$ Millions	Conditions
Minimum	0	0	0	Hot, 1 μ, dry
Maximum	3,800,000	8,200	3,800	1 μ, rain

Using the same assumptions as under A, the area placed under general restrictions would be less than 1200 sq. miles for accidents which might occur during about three-fourths of the time.

IV. Agricultural Restrictions	Area (sq. mi.)	$ Millions	Conditions
Minimum	18	.5	Hot, 1μ, day, dry
Maximum	150,000	4,000.	Hot, 1μ, day, rain

Using the same assumptions as under A, the area placed under agricultural restrictions would be less than 10,000 sq. miles for accidents which might occur during about 93 percent of the time.

(The numbers above are from different cases and hence are not additive).

[fol. 4895] *Observations and Remarks*

The numbers shown in the previous summary are calculated on the basis of what we believe to be the best available assumptions, data and mathematical methods. As has been stressed elsewhere, there is considerable uncertainty about many of the factors, techniques and data, so that these numbers are only rough approximations. Where information is sufficiently complete we have chosen values to represent the most probable situation but where high degrees of uncertainty exist we have chosen values believed to be on the pessimistic (high hazard) side. The results shown would be quite sensitive to variations in some of the factors

which were used. As an example, the amount of fission products actually retained in people's lungs might be quite different from the amount assumed and this difference would change all the personal injury numbers greatly.

In addition there could be weather conditions which, when combined with other imaginable extremely adverse conditions, could result in damages greater than the maximum considered in this study.

The damages calculated for the assumed 50 percent fission product release would vary widely depending upon weather conditions and assumed temperatures of the released materials.

The lethal exposures could range from none to a calculated maximum of 3400. This maximum could only occur under the adverse combination of several conditions which would exist for not more than 10 percent of the time and probably much less.

[fol. 4896] Under the assumed accident conditions, the number of persons that could be injured could range from none to a maximum of 43,000. This high number of injuries could only occur under an adverse combination of conditions which would exist for not more than 10 percent of the time and probably much less.

Depending upon the weather conditions and temperature of the released fission products for the assumed accident, the property damage could be as low as about one-half million and as high as about seven billion dollars. For the assumed conditions under which there might be some moderate restrictions on the use of land or crops (Range IV), the areas affected could range from about 18 square miles to about 150,000 square miles.

[fol. 4897]

PART IV

APPENDICES

[fol. 4899]

APPENDIX A

The Nature and Extent of a Fission Product Release from a Power Reactor

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[fol. 4900]

APPENDIX A

The Nature and Extent of a Fission Product Release from a Power Reactor

Introduction

The principal danger associated with the operation of nuclear reactors of any type is the possible release of the radioactive fission products which they contain. Power reactors are hazardous in this respect because, for economic reasons, they must be operated for long irradiation times and at high power levels. These circumstances lead to large accumulations of fission products. The danger associated with an explosive nuclear energy release in a reactor is quite mild in comparison to the potential hazards from these materials if they should be dispersed. Even in the worst imaginable cases of nuclear runaway the energy release would be comparable only to a mild chemical explosion. Chemical reactions occurring in the wake of a nuclear runaway might in fact contribute more energy than the runaway itself. If power reactors are located at sites similar to those now being proposed, the release of energy accompanying a reactor accident would constitute a negligible hazard to the public. The energy release is important only because it contributes to the possible extent of the fission product release.

[fol. 4901] *Basic Power Reactor Types*

Power reactors may be classified according to three basic constituents: moderator, fuel, and coolant. A few pertinent comments about the principal types may serve to suggest some of the complexities, differences and similarities

relevant to basic problems of safety. Fast reactors are designed in such a way that fissions are caused primarily by the absorption of fast neutrons by the fissionable material. Consequently, these reactors contain only weakly moderating materials. Thermal reactors contain strongly moderating substances such as graphite and water which greatly reduce the energy of the neutrons before they are absorbed. The fissionable fuel may be distributed throughout the reactor in the form of solid rods or plates, in which case the reactor is called heterogeneous, or it may be dispersed in the coolant fluid, in which case the reactor is called homogeneous. Most of the power reactors proposed to date are of the heterogeneous type. Water or liquid metals are among the chief materials now used to extract heat from a power reactor. When water is the moderator it serves also as the coolant. Examples are the pressurized water, the boiling water, and the aqueous homogeneous designs. Fast reactors and graphite-moderated thermal reactors generally utilize liquid metal coolants.

The reactor types differ markedly in engineering design, and each type poses its own peculiar safety problems. Some designs might be more prone to certain types of accidents than others, but it would be exceedingly difficult to compare [fol. 4902] the various power reactor types with regard to safety. It can be expected that before any reactor is approved for construction and operation all known problems relating to safety will have been resolved. In particular, such reactors would be expected to be inherently stable and would be operated according to certain prescribed procedures. They would be equipped with certain customary safety devices, as well as such special ones as their peculiarities dictate. All power reactors would contain substantially the same fission product inventory when operated under similar conditions. While the hazards posed by various reactor types may not be identical, they are at least similar in a number of respects.

Types of Reactor Accidents

Reactors can malfunction in many ways, and in this respect they are no different from other machines. Among other things, such malfunctioning could result from human

errors, equipment failures, design errors, and acts of God. Accidents resulting from such malfunctionings could result in power plant "outage" and damage to the reactor. Only a few types of accidents could plausibly lead to a release of fission products to the atmosphere. Two such accidents, a nuclear runaway and a loss of sufficient coolant to uncover the reactor core, are considered below to illustrate some of the complexities involved.

[fol. 4903] *The Nuclear Runaway*

A nuclear runaway would result if the reactor were made super-critical and all safety instrumentation failed to function. As a consequence, the reactor power and temperature would increase until the runaway were terminated either by the inherent self-stabilizing influence of the reactor or by actual mutilation of the reactor core. A possible consequence of an unchecked runaway could be the meltdown or vaporization of fuel elements and the release of fission products. Another possible consequence could be the initiation of exothermic chemical reactions between certain metals and liquids in the system. Such reactions would assist in the release and dispersal of fission products. However, it is highly improbable that the nuclear and the chemical energy release could cause much mechanical violence beyond the reactor shield. It is therefore feasible to build a gastight container around the reactor which would greatly reduce the chances of a fission product release to the atmosphere, if rupture of the reactor itself should occur.

The possibility of a serious nuclear runaway cannot be completely ruled out, but its occurrence can be made extremely unlikely by careful operating procedure, by adequate design, and by a multiplicity of control devices.

If a nuclear runaway were to occur, its effects would be minimized if the reactor had been designed to be inherently stable. The property of inherent stability implies that the [fol. 4904] production of heat causes physical changes within the reactor which reduce the reactivity. An inherently stable reactor will be self-regulating as soon as, or very shortly after, its temperature begins to rise. Water-

moderated reactors generally possess this self-regulating property to a marked degree, and it seems likely that the property can be designed into all types of reactors to at least some degree.

An inherently stable reactor is not completely immune to destructive runaways, however. In the 1954 Borax experiment it was possible substantially to wreck a stable boiling water reactor by deliberate introduction of a large amount of reactivity at a rapid rate. The self-stabilizing features in reactors may not always operate concurrently with the release of heat by the fission process but may be delayed. If a substantial reactivity were to be introduced into the reactor during this "delay", the reactor would behave essentially as though it were non-self-stabilizing and destruction could be the consequence.

Such large, rapid additions of reactivity are not easily achieved, and in a normally operating reactor could only occur if a series of unlikely misoperations or failures took place. No feature in the design of a reactor receives more attention than those which are incorporated to prevent such inadvertent reactivity additions. Design features and mechanical safeguards, in addition to the inherent self-stabilizing characteristics, are always incorporated to prevent such addition, and these must fail before a potentially hazardous situation would exist.

[fol. 4905] *The Loss of Coolant Accident*

A second major type of accident is the loss of coolant. Such an accident could result from a break in the primary coolant circulating system or from a rupture of the reactor vessel itself. Loss of coolant would permit the radioactive decay heat to melt the uncooled fuel, even though the nuclear reaction had stopped, and thereby permit release of volatile fission products. Calculation indicates that, at least for certain reactor core configurations, further heating of the fuel to the boiling point is precluded by radiation losses.[3] There is the additional possibility that the overheated fuel would react chemically with air entering the reactor, or, in the case of water-moderated reactors, with such water as remains. Such a reaction, if violent, would

help disperse the fission products and might furnish enough energy to break the external reactor container.

Even in the event of a major loop break it is possible to prevent a fuel meltdown by providing for emergency cooling of the core. This may be accomplished by maintaining a large tank of coolant. In any case, the principal line of defense against loss of coolant accidents would be adequate design and care in construction.

The consequences of a loss of coolant could be serious. But the event is highly improbable since it requires the occurrence of an unlikely material failure in the primary [fol. 4906] loop coupled with the unlikely failure of emergency cooling schemes, or else the unlikely failure of the reactor vessel itself.

Chemical Reactions

It has already been mentioned that excessive heating of the reactor through either nuclear runaway or loss of coolant could result in potentially violent chemical reactions. Three principal reactions are: sodium reacting with air, fuel metal reacting with air, and water reacting with fuel metal. The additional possibility exists that hydrogen evolved in the last reaction could react with oxygen.

The first reaction would occur if, as a result of an accident with a sodium cooled reactor, vaporized sodium came in contact with air. The reaction would take place as a rapid but non-violent burning of a vaporized sodium. The only effect of this burning would be to increase the pressure in the reactor's vapor container. Since the vapor container would be designed to withstand the pressure increase resulting from the burning of all the sodium in the reactor, this particular reaction would not be expected to cause a container rupture.

The second reaction would take place if air entered a ruptured reactor vessel and came into contact with hot fuel elements. The result would be rapid oxidation or burning of the metal. The reaction would be non-violent, but it could release a substantial portion of the fission products.

[fol. 4907] The third type of reaction, which is peculiar to heterogeneous water-moderated reactors, would be the only potentially violent one. The metals employed in the construction of fuel elements which would be reactive at high temperatures are zirconium and aluminum and possibly uranium. The total chemical energy available for these water-metal reactions equals or exceeds the energy that would be released in the worst possible nuclear excursion. However, the conditions for anything like a complete reaction would be difficult to achieve. Experience with water-metal reactions in reactors is at present almost totally lacking; therefore, conclusions must be based on information acquired from foundry practice and a few experiments.

The available information on the aluminum-water reaction may be briefly summarized as follows. In aluminum foundry practice, water is frequently used as a quench to form ingots from molten metal. This practice has infrequently led to violent explosions.[5] The occurrence of these explosions has been found to depend very sensitively on such conditions as the depth of the water, the diameter of the molten stream, and the presence of impurities. For example, a coating of grease on the water container was found to prevent the explosion, while iron rust was found to increase the tendency for explosion. Weils and West[6] at Argonne National Laboratory performed the experiment of pouring molten aluminum into water without obtaining an explosive reaction. Molten aluminum was also poured into water in an experiment at the Aerojet General [fol. 4908] Corporation Laboratories. The experiment was then modified by using a blasting cap to disperse the metal. Explosions failed to occur in either case; only the formation of an oxide film took place.[7] The conclusion to be drawn from the Argonne and the Aerojet General work is that a violent explosion will not occur under the special conditions of these experiments. Finally, it should be mentioned that, in the destructive Borax experiment, a meltdown of aluminum-clad fuel elements failed to produce an explosive water-metal reaction.[8]

Experiments performed at Westinghouse;[9] Aerojet General[7], and North American Aviation[10] indicate that the

zirconium-water reaction can be either a rapid oxidation or a violent explosion, depending on whether the zirconium is in massive form or finely dispersed. In the first case the reaction becomes noticeable at about 1200°C; well below the melting point of zirconium. In the presence of water the reaction becomes noticeable at about 1200°C, well below of heat is removed; while in the presence of steam the reaction is expected to proceed autocatalytically, i.e., the reaction, once started, will proceed without the application of external heat. In the experiments with dispersed zirconium and water the dispersal was brought about either by detonation of a blasting cap below the surface of the water while molten zirconium was poured in or by explosion of zirconium wires in water by means of rapidly discharging condensers. In either case the zirconium present reacted more or less completely with explosive violence.

[fol. 4909] A theoretical analysis has been made at Westinghouse to determine the maximum possible extent of a water-metal reaction occurring in a pressurized water reactor. It was hypothesized that a major break had occurred in the coolant loop, resulting in loss of water and the complete uncovering of the reactor core. The temperature of the zirconium-uranium fuel elements would soon rise as a result of the fission product decay heat. When the metal reached 1200°C, the fuel elements would begin to react with the steam present in the core. The reaction would then proceed autocatalytically until the metal temperature was brought to the melting point. The melting would take place slowly releasing droplets which would fall into the remaining water below. At this point the water-metal reaction would be quickly quenched. By using experimentally determined heating curves for the water-zirconium system, a calculation was made of the amount of zirconium that could react from the inception of the reaction to the time of its quenching by heat losses from the metal droplets to the water. The maximum possible percentage of the metal which could react in this most favorable case was estimated to be 25 percent.

In the course of a water-metal reaction, hydrogen gas would be evolved which could react with oxygen after leaving the reactor. If the hydrogen exceeds a certain

critical concentration, an explosion is possible. But a very substantial amount of hydrogen would be required to raise the hydrogen concentration in the vapor container to this [fol. 4910] critical level. A certain quantity of hydrogen would be produced within the reactor as a result of its usual operation, but this amount is so small that it would constitute no explosive hazard. Since the evolution of hydrogen from the water-metal reaction would take place slowly, it could be burned before explosive concentrations are reached. In some installations to insure that hydrogen burns as it is evolved, a number of electric igniters are located throughout the vapor container.

To summarize, the chemical reaction which poses the most serious danger in the event of a reactor accident is the water-metal reaction. This reaction, however, would be expected to proceed as a vigorous but incomplete oxidation of the metal at elevated temperatures. In the case of zirconium, it is expected that no more than 25 percent of the metal would react. A violent and more or less complete reaction of the metal would require the metal to be finely dispersed. Such a dispersal could occur only as a result of fuel vaporization, which was previously pointed out to be a highly unlikely event.

The Function of Vapor Containers

Since the energy release (whether chemical, nuclear, or both) which might accompany a reactor accident is expected to be of comparatively mild intensity, it is feasible to construct a steel shell to confine the fission products which might escape from the reactor. Because of the large volume [fol. 4911] of such a shell, it can be readily designed to withstand the pressure loading resulting from accidents capable of rupturing the reactor vessel. Presumably it would be impractical to design such a vapor container to confine the worst conceivable accidents. It is designed rather to contain all credible accidents. For example, the vapor container for a pressurized water reactor would be designed to withstand either the pressure resulting from a water release or 25 percent of the energy available for a chemical reaction, but not both simultaneously. In this case,

calculation indicates that the pressure produced by the first event would be relieved through heat losses from the container before the second event could take place.

There is always the possibility that the vapor container could be penetrated by flying fragments resulting from failures in the system. The use of ductile metals in construction would greatly reduce the probability of such failures and therefore the probability of missile formation. In addition, the resistance of the vapor container to the penetration by missiles could be increased by lining the inside of the shell with a layer of reinforced concrete.

While the vapor shell could probably not withstand severe shock-wave effects, it is considered extremely unlikely that such shock phenomena could be initiated by either a nuclear or a chemical energy release. The speed of a nuclear excursion would be limited by the lack of means of introducing reactivity rapidly into the reactor system, while the speed of a chemical energy release would probably be governed [fol. 4912] by the rate of mixing of the reactants. In either case the energy release could be expected to be much slower and less destructive than an equivalent energy release from a detonating explosive. Energy releases calculated for reactor accidents are sometimes expressed in TNT weight equivalents. Such comparisons ignore the fact that the rates of energy release in the two cases may be greatly different. The damage in the reactor thus is overestimated.

Thus the vapor container surrounding a reactor may be considered another line of defense for the protection of the public. These structures are not impregnable, but they are designed to be capable of confining the accidents which can be regarded as credible.

The Extent of Fission Product Release

The question is now raised: in the highly unlikely event of a reactor accident which leads to a rupture in both the reactor vessel and its vapor container, what would be the expected percentage release of the fission products? The answer to this question depends in a complicated way on the details of the accident. Various possible accident situations could lead to different amounts of fission product release, e.g., fuel meltdown unaccompanied by a chemical reaction; meltdown followed by a non-violent oxidation of

the metal by water; meltdown in the presence of air accompanied by combustion of the metal; and either violent chemical reaction or vaporization, or both.

[fol. 4913] The first situation would require that no water be present in the reactor and that no combustion take place. The latter requirement could be met if the fuel elements have a melting temperature well below the temperature required for rapid combustion. In experiments performed at Oak Ridge National Laboratory, Parker[11] has electrically melted uranium-aluminum fuel elements in the presence of air without causing combustion. It can be reasonably assumed that in an accident situation molten fuel metal will quickly assume a physical shape which is no longer conducive to the molten state; e.g., it can form into drops which fall and resolidify. In the previously mentioned experiments Parker observed that, if the irradiated molten uranium-aluminum fuel element is refrozen within a few seconds, about 60 percent of the noble gases, xenon and krypton, leave the metal in addition to about 25 percent of the iodine. The percentage of the bromine escaping can be reasonably assumed to equal that of the iodine. Once resolidification of the fuel has taken place, the escape of radioactivity would be expected to stop. While these fission products make up the bulk of the released radioactivity, minute quantities of less volatile substances such as tellurium were also detected to have escaped from the metal. It is reasonable to assume that other metals having similar volatility, such as strontium, could escape in minute quantities as well.

[fol. 4914] In the second situation, the release of the more volatile fission products is assisted by the oxidation of the metal by water. Two hydrogen atoms are released for every atom of metal oxidized, and, in the course of escaping, the evolved hydrogen disrupts from the lattice atoms of the more volatile elements, which likewise escape. Experiments have been carried out at the Westinghouse Atomic Power Division to determine what products are released as a result of the corrosion by water of irradiated uranium metal.[12] These experiments were performed at relatively low temperatures (600°F). The fairly volatile metals cesium and rubidium were observed to escape quantitatively, while the less volatile barium and the biologically important element

strontium were found to escape only to the extent of 5 percent. It seems reasonable to assume that the gaseous elements, halogens and the noble gases, would also escape quantitatively although no determination was made. Unfortunately, such data are not available for the corrosion of more typical reactor fuels such as uranium-zirconium alloy at more realistic temperatures. In any case, the evolution and escape of hydrogen gas are expected to govern the release of fission products. It can be argued that the behavior of the hydrogen should not depend strongly on the metal being oxidized and that therefore the fission product release observed for uranium is a likely one for other reactor fuels as well. According to Westinghouse estimates, a maximum of 25 percent of the zirconium-[fol. 4915] uranium fuel could be oxidized by water. Therefore, the maximum expected release of strontium in case of a complete fuel meltdown in the presence of water would be 5 percent of 25 percent or 1 percent, on the assumption that negligible amounts of strontium are released from the unreacted metal. On the basis of Parker's data the same release could be expected to include 70 percent of the noble gases and 44 percent of the halogens as well as less important percentages of some of the volatile metals.

The third situation could occur if the fuel element melting temperature were high enough for combustion to accompany melting. The process of combustion would involve considerable disruption of the oxidizing material and would cause the release of a substantial fraction of the fission products. Parker observed that uranium-stainless steel fuel elements burned vigorously after rapid heating to 2000°C and that 50 percent of the total gamma activity of the fuel element was removed as a result. If all the noble gases and halogens are assumed to escape, it could be inferred that 25 percent of the remaining fission products were removed. Zirconium-uranium alloy has a high melting temperature (about 1800°C), therefore, it might be a candidate for combustion. Parker, however, observed that zirconium-uranium fuel elements heated slowly to the melting point did not burn. Such slow heating should reasonably simulate the melting of fuel elements by decay heat.

[fol. 4916] Actually, in the case of a pressurized water reactor it is highly doubtful that air could even enter the

core while the fuel was in the molten state, the reason being that steam at greater than atmospheric pressure would fill the core for a matter of hours following the loop failure. It is conceivable in some reactor designs that air could enter the core following a coolant loop rupture; however, in view of Parker's observations it appears doubtful that combustion would occur.

The final situation could lead to substantial dispersal of the fuel. Whether this would significantly augment the release of fission products is open to question. It is reasonable to assume that fission products would escape quantitatively from the metal that had reacted or vaporized; but it is doubtful whether major portions of fuel could vaporize or react violently even in the unlikely event that these two processes did take place. The dispersed metal should behave substantially as in the first and second situations already discussed. Thus, even in the case of violent disruption within the reactor, the fission product release should not be expected to exceed substantially the release in the case of fuel combustion.

Conclusions

On the basis of the best available information, the mechanism fission product release most likely to occur, appear to be either a fuel meltdown or a meltdown accompanied by an oxidation of fuel by water, depending on whether or not water is present in the reactor. In the former case, the [fol. 4917] release would be confined to about half the noble gases and about a quarter of the halogens contained in the fuel. In the latter case, the release would consist primarily of a somewhat more complete release of these same volatiles in addition to approximately 1 percent of the contained strontium.

A meltdown followed by combustion could result in a release of 50 percent of the contained radioactivity. A conservative guess would be that a like percentage of strontium would be released. In the light of experimental evidence this type of release seems less likely than either of the first two. Finally, a violent release could not reasonably be expected to exceed 50 percent. Such a mode of release would also be unlikely.

Speculation has so far been concerned only with the escape of fission products from reactor fuel and has not taken into account the condensation and absorption of these substances on metal surfaces in the reactor and vapor container during their passage to the atmosphere. The preceding estimates are therefore somewhat conservative, at least in the case of the less volatile fission products; but since these estimates involve uncertainties, there is some justification for conservatism.

[fol. 4918] *References*

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[fol. 4920] APPENDIX B

Description of Reactor and Site

[fol. 4921] APPENDIX B

Description of Reactor and Site

Description of Reactor

The reactor chosen for this study is a 500,000 thermal kilowatt reactor. This power rating is in the range of the ratings of the large power reactors now proposed. However, since all the cost analyses that have been performed on reactors show that the cost per kilowatt-hour of electricity decreases with increase in reactor power, it is expected that the power level of future reactors will tend to be large.

The reactor is assumed to be fueled with Uranium 235. Also, the fuel reprocessing cycle is taken to be 180 days. This time interval seems appropriate for reactors now proposed.

Description of Site

It is assumed in this report that the reactor would be 30 miles from a large city, and located near a large body of water. It is logical to place the reactor near the users of power, since transmission costs are proportional to distance; on the other hand, land costs are less outside the city than inside. Nearness to a water supply is postulated because water is necessary for steam condensation. All the power reactor sites proposed to date are within 30 to 40 miles of a city and near an adequate water source.

[fol. 4922] Choice of a typical distribution of population around a reactor site was arrived at by a consideration of the actual distribution around five reactor sites. It develops that the total population within given radial distances (R) of less than 30 miles is remarkably similar for these sites. This population can be calculated by the expression Population $= 200\ R^{2.83}$ where R is in miles. Figure 1 shows the

population curves for three government controlled sites and two proposed private sites with the above population equation plotted. At medium distances the actual populations around the proposed commercial sites are lower than those calculated from this equation by a factor of up to 4. This is about the same as azimuthal variation. It should be noted that the government sites have been in existence for some time. It would be expected that more people and factories would move into the region 10 to 20 miles from a new reactor as time goes by, so that the areas around commercial sites would become like those around the government sites, for which the population equation is quite good.

For distances greater than 30 miles, population density is assumed to be 500 people per square mile rather than the United States average of 55 per square mile. The states with high population densities have been deliberately chosen because power reactors are expected to be built in regions where there are many power users. Examples of population densities in some industrial states as given in "The Statistical Abstract of the United States, 1955", are:

[fol. 4923]

	Population Density, people/mi²	
	1940	1950
Rhode Island	674	748
New Jersey	553	643
Massachusetts	545	596
New York	281	309

The above numbers show that population densities are increasing at a very rapid rate.

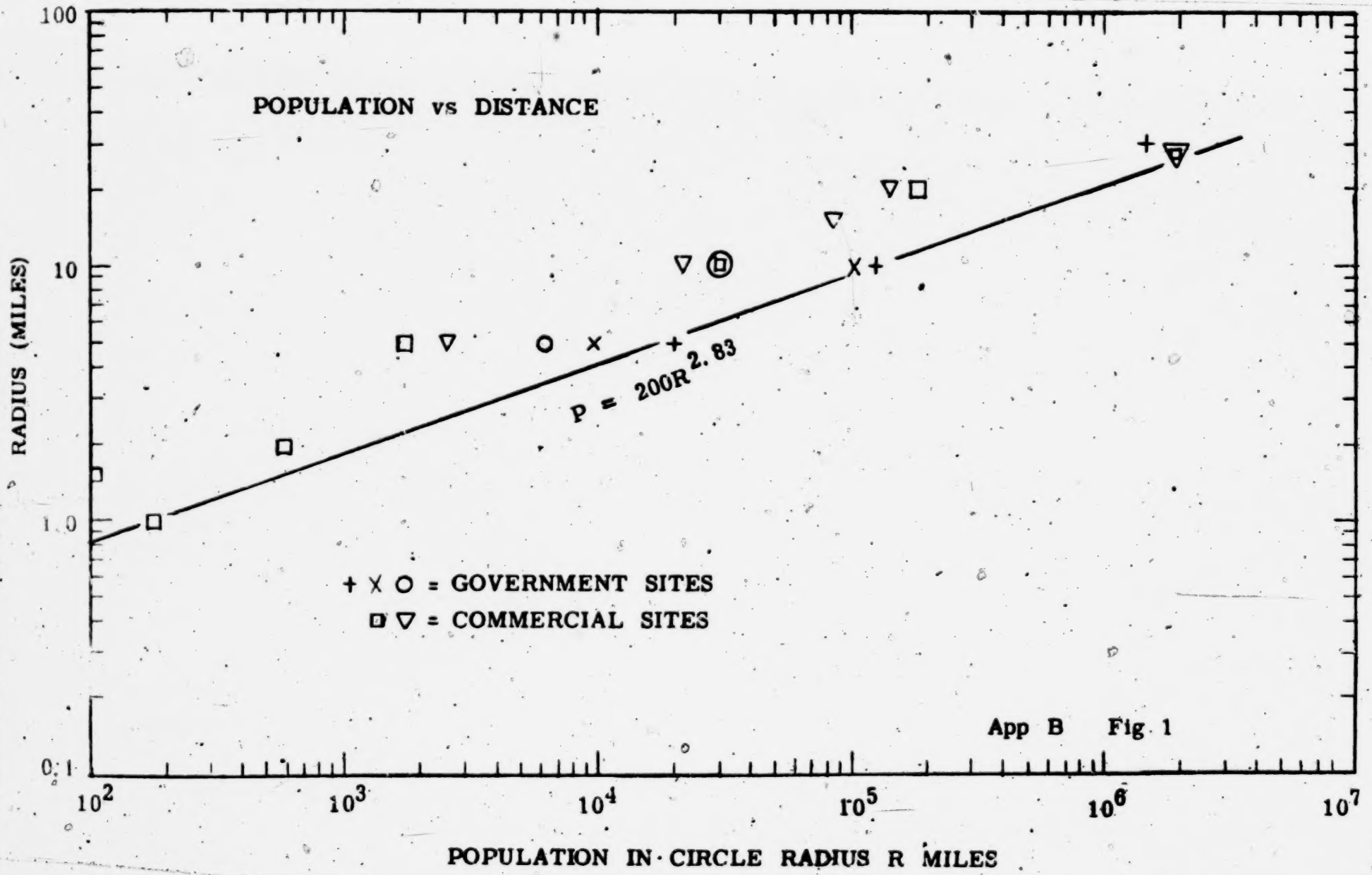
The choice of the characteristics of the nearby city was difficult. For purposes of calculation the city was assumed to have one million people uniformly dispersed over a circular area of 15-kilometer (about 10 miles) radius. While no city of this exact description exists, it is felt that such characteristics provide a reasonable basis for the calculation of hypothetical damages.

Figures

Figure 1. Population vs. Distance.

(See opposite)☞

RADIUS (MILES)



App B Fig 1

4524

[fol. 6846]

BEFORE THE ATOMIC ENERGY COMMISSION

Docket No. F-16

In the Matter of

POWER REACTOR DEVELOPMENT COMPANY

OPINION AND INITIAL DECISION

This matter comes before the Commission on an application by the Power Reactor Development Company (hereinafter called PRDC) for a facilities license under Section 104(b)[1] of the Atomic Energy Act of 1954, as amended, 42, U.S.C., Sec. 2134(b). The application was filed January 6, 1956 and, as amended by ten amendments, requests a class 104(b) license for a period of twenty-five years for a fast breeder reactor system described in the application. The precise question before the Commission is whether the provisional construction permit of August 4, 1956, arising from the license application and described below, should be continued, modified, suspended, revoked or otherwise disposed of. The reactor as described would have a rated capacity of 300,000 thermal kilowatts and 100,000 electric kilowatts. The proposed location of the plant is at Lagoona Beach, approximately thirty miles south of Detroit, Michigan, on land leased from the Detroit Edison Company. Notice of the filing of the application was published in the Federal Register on June 27, 1956.

[fol. 6847] PRDC is a non-profit membership corporation organized under the laws of the State of Michigan. Its membership includes public utilities and equipment manufacturers interested in the advance and development of the peaceful use of atomic energy. By contract it has engaged the technical services of Atomic Power Development Associates, Inc. (hereinafter called APDA), which is a non-profit membership company organized under the laws

[1] Quoted *infra*, page 13.

of the State of New York. APDA's organizational structure includes companies and individuals engaged in the study of fast breeder technology. The memberships of PRDC and APDA are largely duplicatory; thirteen of the twenty-one members of PRDC, including all but two of the utility members, are members of APDA and a fourteenth PRDC member represents four member operating companies of APDA. The president of Detroit Edison Company is also president of PRDC and APDA.

The contract between PRDC and APDA provides for APDA to furnish PRDC with the complete design for the proposed reactor and with technical services in connection with reactor components. The agreement likewise provides for APDA to procure and assemble the "component test facility" and to conduct extensive non-nuclear tests with it. Upon completion of those tests APDA will transfer to PRDC that facility, which for practical purposes is the proposed reactor with dummy fuel and one-third of the primary coolant loops.

Detroit Edison Company has agreed with PRDC to buy the steam generated by the reactor and to furnish PRDC with housekeeping services. Detroit Edison plans to install conventional steam generating facilities in association with the reactor and to introduce the electric power so generated into its regular power net.

[fol. 6848] The license application states that the earliest date for completion, in the sense of finishing construction to the point of introducing nuclear fuel, of the reactor is December 15, 1959, and the latest date is December 15, 1960. Statements in the record make it clear that construction is now expected to be finished about September of 1960. According to the license application, the member companies of PRDC had committed themselves, subject to call, to provide financing which was expected to be sufficient, when augmented by some $15 million of loans which had been arranged with banks, and some further commitments made by member companies, to cover the anticipated cost of construction and operation of the proposed plant. The application requested an allocation of nuclear material for fuel sufficient to cover an operating period of twenty-five years.

On August 4, 1956 the Commission issued a conditional or provisional construction permit for the proposed project, and reserved nuclear materials for it, but it took no action with respect to a license to operate the plant. Notice of the issuance of the construction permit was given by publication in the *Federal Register* (21 FR 5974). The permit specifically provided that conversion to a license depended upon satisfactorily showing that the final design of the reactor gave reasonable assurance that the health and safety of the public would not be adversely affected by its operation. The permit further provided for its expiration unless within one year the Applicant provided sufficient data to enable the Commission to make the findings of financial qualification required by the Atomic Energy Act and the Commission's regulations. The Commission, on August 1, 1957, extended the time for this submission and for the evaluation of that evidence.

[fol. 6849] On August 31, 1956 the International Union, United Automobile, Aircraft, and Agricultural Implement Workers of America, affiliated with the American Federation of Labor-Congress of Industrial Organizations, and Walter P. Reuther, Emil Mazey, and Carlos Gastambide, described as officers and members of the UAW, petitioned to intervene, sought a formal hearing, and requested the Commission to suspend the construction permit theretofore issued. Similar petitions were filed by the International Union, United Paper Workers of America, affiliated with the American Federation of Labor-Congress of Industrial Organizations, and six individuals identified as officers and members thereof, and by the International Union of Electrical, Radio and Machine Workers, likewise affiliated with the AFL-CIO, and three individuals described as officers and members thereof (these three labor unions and their officers and members referred to will hereafter be collectively called "Interveners"). The petitions to intervene were granted on October 8, 1956. On the same date the Commission issued a notice of hearing, order and memorandum directing that a hearing be held before Jay A. Kyle, Examiner, on issues designated by the Commission. Those issues were set forth by the Commission as follows:

A. 1. Whether there is information sufficient to provide reasonable assurance that a utilization facility of the general type proposed in the application can be constructed and operated at the location proposed therein without undue risk to the health and safety of the public.

[fol. 6850] 2. Whether there is reasonable assurance that technical information omitted from and required to complete the application will be supplied.

B. Whether, pursuant to Section 50.40(b) of the Commission's regulations, the Applicant is financially qualified to engage in the proposed activities; and whether, pursuant to Section 50.60(c)(2) of the Commission's regulations, the Applicant is financially qualified to receive an allocation of special nuclear material.

C. With respect to any matter in controversy in this proceeding, whether the Commission may, or should, grant any exemption pursuant to Section 50.12 of its regulations on the ground that such exemption is "authorized by law and will not endanger life or property or the common defense and security and . . . [is] otherwise in the public interest."

D. If the issues in the proceeding are resolved in favor of continuing the construction permit, what additional or different provisions, if any, should be incorporated in it.

The Commission's order provided that the Examiner should certify the record to the Commission at the conclusion of the hearing, and the Examiner did so on November 22, 1957. Answers were filed to the notice of hearing by both PRDC and the Interveners, and various motions were likewise filed and appropriately disposed of; they were considered in orders issued by the Commission on October 3 and 8 and December 12, 1956. There was a [fol. 6851] prehearing conference on November 29, 1956, and the hearing lasted, with intermittent recesses, from January 8, 1957 to August 7, 1957. In the meanwhile, on

March 4, 1957, the State of Michigan, through its Attorney General, petitioned to intervene and participate in the proceedings. Intervention was granted to the State of Michigan, but intervention was denied to one Elliott Earl who sought intervention on August 15, 1957. The State of Michigan has never taken any firm position with respect to the construction permit but has only emphasized its responsibility for the health, safety and welfare of its citizens.

Much of the testimony in the hearing was submitted in written narrative form in accordance with the permission granted by an order of the hearing Examiner issued November 29, 1956. Objection by the Interveners to the submission of written narrative testimony was overruled by the Examiner on January 29, 1957, and the Commission on February 28, 1957 denied an interlocutory appeal from this order.

In addition to the testimony elicited in the course of the hearing, statements were received from the AFL-CIO, State of Michigan, and the Cooperative League of the U.S.A., and these statements were included in the record. Briefs were subsequently filed by the Applicant and the Interveners, and the cause was argued orally before the Commission on May 29, 1958. The Commission has considered the complete record of the evidence and the briefs and arguments presented.

In addition to contentions regarding lack of due process, the Interveners, in their petition for intervention, alleged that the Commission violated the Atomic Energy Act in granting a conditional construction permit, and based that conclusion on four grounds which remain the foundation of their position through brief and oral argument. These four grounds, as stated in the Interveners brief, were:

> [fol. 6852] (a) The Commission violated Section 185 of the Act by failing to make a finding requisite to the grant of a construction permit on a provisional basis, under Section 50.35, Title 10 CFR, that the Commission is satisfied that it has information sufficient to provide reasonable assurance that a utilization facility of the general type proposed can be constructed and operated

at the proposed location without undue risk to the health and safety of the public; and

(b) The Commission violated Section 185 of the Act, as implemented and interpreted by Section 50.40(b), Title 10 CFR, by failing to make a finding that PRDC is financially qualified to engage in the proposed activities in accordance with Commission regulations; and

(c) The Commission violated Section 185 of the Act, as implemented and interpreted by Section 50.60(b), Title 10 CFR, by failing to make a finding that PRDC is financially qualified to assume responsibilities for payment of Commission charges for materials, and to undertake and carry out the proposed use of special nuclear materials for a reasonable period of time; and

(d) The Commission violated Section 185 of the Act and the aforesaid regulations by making an allocation of special nuclear material to PRDC without the requisite finding of financial qualifications.

[fol. 6853] These grounds were summarized on oral argument by counsel for the Intervenors as the inherent lack of safety of the reactor as designed, its special hazard in the selected location, and the financial inability of the Applicants to construct and operate the reactor.

[fol. 6854] A brief description of the proposed reactor will show that it is the largest of this particular type so far proposed to be erected in the United States. The reactor vessel and core would be housed in a reactor building, which would in turn be housed in a containment structure, 120 feet high and 72 feet in diameter, of welded carbon steel. The reactor vessel is welded stainless steel, 36 feet high, with a diameter, enclosing the core and blanket, of 9.5 feet in the lower section and of 14.5 feet in the upper section. For biological shielding, as well as other purposes, this vessel would contain twelve inches of stainless steel in the lower portion, thirty inches of borated graphite between the lower reactor vessel and the primary shield tank, and a 3.5 foot concrete wall enclosing the reactor vessel and the primary coolant system; and a seven foot concrete wall

and five feet of concrete and steel flooring would enclose the entire reactor compartment. The core of the reactor is to be a cylinder approximately 30.5 inches in diameter by 31.2 inches high, consisting of uranium pins 27% enriched in the isotope U-235, clad in zirconium and held in square stainless steel subassemblies. A blanket of uranium depleted in the isotope U-235 would surround this core and would comprise, with the core, a cylinder 78.5 inches in diameter and 67 inches long. The reactor is designed to be cooled by 5000 cubic feet of liquid sodium, pumped by electric pumps upward through the core and blanket, thence through three primary coolant loops, to heat-exchangers, and then back to the reactor vessel, with a secondary coolant system of liquid sodium in three loops between the primary coolant and the steam generator where its heat is converted into steam. This dual system is provided to prevent the chemical reactions that would take place if the radioactive sodium [fol. 6855] in the primary system had a chance to reach the water in the steam generator.

Classification of reactors may be made in several ways, but one ground for classification is the speed of the utilized neutrons. In the chain reaction process, neutrons are released by the fission of radioactive atomic nuclei and strike the nuclei of other fissionable atoms, which in turn fission and release their own neutrons against other atoms in the continuing process. When a Uranium-235 nucleus fissions, it releases its neutrons at an average speed of about 10,000 miles per second. If the design of the reactor is such that it can utilize the neutrons moving at or near this speed, it is called a "fast" reactor. If, however, the reactor employs as a "moderator" one of the materials, such as for example, graphite, either ordinary or heavy water, or beryllium, which has the ability to slow down neutrons to a speed of about one mile per second without capturing those neutrons, and if it employs those relatively slow moving nuclear particles in the chain reaction, it is called a "thermal" reactor.

Not all the neutrons released by the fissioning atom produce more fissions; some neutrons escape, and others are captured by fertile but non-fissionable atoms like Uranium-238, the isotope which constitutes 99.3% of all the uranium

in nature. Instead of stabilizing as Uranium-239, however, such an atom passes through a brief existence in the form of Neptunium-239 and then stabilizes as plutonium which [fol. 6856] is itself fissionable. If a reactor is so designed that its Uranium-238 atoms capture neutrons and therefore change into plutonium atoms at a rate greater than the rate at which the Uranium-235 atoms are fissioning, it is called a "breeder." The proposed PRDC reactor is so designed, and its conversion ratio is 1.20, or, in other words, it is designed to produce 20% more fissionable material than it consumes.

The safety and control mechanism for the reactor core includes rods containing Boron 10, which reduces radioactivity by absorbing neutrons. These rods control the radioactivity in the core by their insertion into or withdrawal from the core, and they are designed so that in the event of a mechanical or electrical failure, their magnetic grips will release them to drop into the core.

There would also be associated buildings for such purposes as storage of new and spent fuel elements, w[illegible] storage, clean-up and storage of sodium and inert gas, repair shop, laboratory, general services, holding basins for liquid wastes, etc.

As in the case of any other power reactor at this stage of the art, in addition to the design features of the reactor which will be determined and demonstrated before the actual construction of the reactor, many will be determined and demonstrated during its actual construction.

[fol. 6857] Congress, in the Atomic Energy Act, provided for two types of licenses: the Section 103[2] class of license

[2] Sec. 103. Commercial Licenses.

a. Subsequent to a finding by the Commission as required in section 102, the Commission may issue licenses to transfer or receive in interstate commerce, manufacture, produce, transfer, acquire, possess, use, import, or export under the terms of an agreement for cooperation arranged pursuant to section 123, such type of utilization or production facility. Such licenses shall be issued in accordance with the provisions of chapter 16 and subject to such conditions as the Commission may by rule or regulation establish to effectuate the purposes and provisions of this Act.

b. The Commission shall issue such licenses on a non-exclusive basis to persons applying therefor (1) whose proposed activities

requires a finding that the proposed utilization or production facility has been sufficiently developed to be of practical [fol. 6858] value for industrial or commercial purposes; the Section 104[3] class of license, in addition to the medical

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will serve a useful purpose proportionate to the quantities of special nuclear material or source material to be utilized, (2) who are equipped to observe and who agree to observe such safety standards to protect health and to minimize danger to life or property as the Commission may by rule establish; and (3) who agree to make available to the Commission such technical information and data concerning activities under such licenses as the Commission may determine necessary to promote the common defense and security and to protect the health and safety of the public. All such information may be used by the Commission only for the purposes of the common defense and security and to protect the health and safety of the public.

c. Each such license shall be issued for a specified period, as determined by the Commission, depending on the type of activity to be licensed, but not exceeding forty years, and may be renewed upon the expiration of such period.

d. No license under this section may be given to any person for activities which are not under or within the jurisdiction of the United States, except for the export of production or utilization facilities under terms of an agreement for cooperation arranged pursuant to section 123, or except under the provisions of section 109. No license may be issued to an alien or any corporation or other entity if the Commission knows or has reason to believe it is owned, controlled, or dominated by an alien, a foreign corporation, or a foreign government. In any event, no license may be issued to any person within the United States if, in the opinion of the Commission, the issuance of a license to such person would be inimical to the common defense and security or to the health and safety of the public.

[3] Sec. 104. Medical Therapy and Research and Development.

a. The Commission is authorized to issue licenses to persons applying therefor for utilization facilities for use in medical therapy. In issuing such licenses the Commission is directed to permit the widest amount of effective medical therapy possible with the amount of special nuclear material available for such purposes and to impose the minimum amount of regulation consistent with its obligations under this Act to promote the common defense and security and to protect the health and safety of the public.

b. The Commission is authorized to issue licenses to persons applying therefor for utilization and production facilities involved in the conduct of research and development activities leading to the demonstration of the practical value of such facilities for in-

[fol. 6859] therapy provisions not pertinent to this case, is of a research and development character and envisions progress toward practical applications. The rules and regulations of the Commission with regard to licenses do not make a distinction between Section 103 and Section 104 licenses because Section 185[4] of the Act, providing for

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dustrial or commercial purposes. In issuing licenses under this subsection, the Commission shall impose the minimum amount of such regulations and terms of license as will permit the Commission to fulfill its obligations under this Act to promote the common defense and security and to protect the health and safety of the public and will be compatible with the regulations and terms of license which would apply in the event that a commercial license were later to be issued pursuant to section 103 for that type of facility. In issuing such licenses, priority shall be given to those activities which will, in the opinion of the Commission, lead to major advance in the application of atomic energy for industrial or commercial purposes.

c. The Commission is authorized to issue licenses to persons applying therefor for utilization and production facilities useful in the conduct of research and development activities of the types specified in section 31 and which are not facilities of the type specified in subsection 104b. The Commission is directed to impose only such minimum amount of regulation of the licensee as the Commission finds will permit the Commission to fulfill its obligations under this Act to promote the common defense and security and to protect the health and safety of the public and will permit the conduct of widespread and diverse research and development.

d. No license under this section may be given to any person for activities which are not under or within the jurisdiction of the United States, except for the export of production or utilization facilities under terms of an agreement for cooperation arranged pursuant to section 123 or except under the provisions of section 109. No license may be issued to any corporation or other entity if the Commission knows or has reason to believe it is owned, controlled, or dominated by an alien, a foreign corporation, or a foreign government. In any event, no license may be issued to any person within the United States if, in the opinion of the Commission, the issuance of a license to such person would be inimical to the common defense and security or to the health and safety of the public.

[4] Sec. 185. Construction Permits.

All applicants for licenses to construct or modify production or utilization facilities shall, if the application is otherwise acceptable to the Commission, be initially granted a construction permit. The construction permit shall state the earliest and latest dates for the

construction permits, was intended by the Congress to apply to both Section 103 and Section 104 licenses. It thus appears that our rules are designed to provide for Commission determination of the form and scope of a construction permit as appropriate in a particular case, depending upon the particular state of research and development currently applicable to the proposed project.

[fol. 6860] The Commission has published regulations pursuant to its authority under the statute, and certain portions of those regulations have a bearing on the safety issue in this case. The basic statement of the standards under which the Commission will issue licenses is Regulation 50.40 (10 CFR 50.40).

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completion of the construction or modification. Unless the construction or modification of the facility is completed by the completion date, the construction permit shall expire, and all rights thereunder be forfeited, unless upon good cause shown, the Commission extends the completion date. Upon the completion of the construction or modification of the facility, upon the filing of any additional information needed to bring the original application up to date, and upon finding that the facility authorized has been constructed and will operate in conformity with the application as amended and in conformity with the provisions of this Act and of the rules and regulations of the Commission, and in the absence of any good cause being shown to the Commission why the granting of a license would not be in accordance with the provisions of this Act, the Commission shall thereupon issue a license to the applicant. For all other purposes of this Act, a construction permit is deemed to be a "license".

§ 50.40 *Common Standards.* In determining that a license will be issued to an applicant, the Commission will be guided by the following considerations:

(a) The processes to be performed, the operating procedures, the facility and equipment, the use of the facility, and other technical specifications, or the proposals in regard to any of the foregoing collectively provide reasonable assurance that the applicant will comply with the regulations in this chapter, including the regulations in Part 20, and that the health and safety of the public will not be endangered.

(b) The applicant is technically and financially qualified to engage in the proposed activities in accordance with the regulations in this chapter.

(c) The issuance of a license to the applicant will not, in the opinion of the Commission, be inimical to the common defense and security or to the health and safety of the public.

Also relevant on the standards for issuing licenses, and showing that the construction permit is a step toward a license rather than the equivalent of it, is Regulation 50.45 (10 CFR 50.45).

Actual issuance of both licenses and construction permits is covered by Regulation 50.50 (10 CFR 50.50). [fol. 6861] But the regulation most vitally involved in the present issue is Regulation 50.35 (10 CFR 50.35).

The position of the Intervenors in their brief and on oral argument was that issuance of the construction permit violated the Commission's own regulations and that therefore its issuance was illegal. This position was founded on an interpretation of the statute and regulations to the effect that all the same findings as the Commission would have to

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[5] 50.45 *Standards for construction permits.* An applicant for a license or an amendment of a license who proposes to construct or alter a production or utilization facility will be initially granted a construction permit, if the application is in conformity with and acceptable under the criteria of subsection 50.31 through 50.38 and the standards of subsection 50.40 through 50.43.

[6] 50.50 *Issuance of licenses and construction permits.* Upon determination that an application for a license meets the standards and requirements of the act and regulations, and that notification, if any, to other agencies or bodies have been duly made, the Commission will issue a license, or if appropriate a construction permit, in such form and containing such conditions and limitations including technical specifications, as it deems appropriate and necessary.

[7] 50.35 *Extended time for providing technical information.* Where, because of the nature of a proposed project, an applicant is not in a position to supply initially all of the technical information otherwise required to complete the application, he shall indicate the reason, the items or kinds of information omitted, and the approximate times when such data will be produced. If the Commission is satisfied that it has information sufficient to provide reasonable assurance that a facility of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public and that the omitted information will be supplied, it may process the application and issue a construction permit on a provisional basis without the omitted information subject to its later production and an evaluation by the Commission that the final design provides reasonable assurance that the health and safety of the public will not be endangered.

make in order to issue a license must also be made in order to issue a construction permit. The Intervenors in other words maintain that insofar as its factual foundation is concerned, the distinction between a construction permit and a license is only in the name, and that unless there is sufficient foundation in the record now for the issuance of a license to operate, the construction permit should be suspended and construction should stop. With this interpretation we cannot agree.

[fol. 6862] There can be no doubt that public safety is the first, last, and a permanent consideration in any decision on the issuance of a construction permit or a license to operate a nuclear facility. The Commission regards the importance of public safety so highly that it considers that it does not lose jurisdiction of this subject even after a license has been issued, at any stage in the course of its construction, or, for that matter, even after a facility is in operation. Although not very likely, newly discovered scientific knowledge could conceivably indicate an unanticipated hazard even after some years of operation of a facility, and we regard the Commission in such circumstances to be obliged by the law to take appropriate action.*

Sections 104 and 185 of the statute, and pertinent regulations, particularly Section 50.35, on their face, however, negate the synonymity of the construction permit and the license to operate, and their meaning is clear. The very fact that the construction permit is referred to as the natural precursor of the license emphasizes the distinction between them, and the distinction is well established in the systems of other administrative agencies.

[fol. 6863] Everyone agrees, including the Interveners in their brief and on oral argument, that there is no hazard to the public in the construction of the reactor beyond that which is inherent in any other heavy construction. The only

* Although our knowledge of it is limited to press reports, we recall the recent experience of a British manufactured turbine powered aircraft type, which, although fully licensed on the basis of the usual exhaustive tests by the appropriate British authority, after transporting a great many commercial passengers over a period of months, proved to be structurally deficient and therefore hazardous. All aircraft of this particular type were promptly grounded, and they never returned to commercial service.

question of hazard to the public clearly rises when the time arrives for the reactor to go critical. The issue as seen by the Interveners, however, is that construction of the reactor inevitably means its operation. This contention is based on the argument that the heavy investment in the reactor will generate irresistible pressure for its operation so as to protect the investment itself; corollary is the position that it would be unfair to PRDC to permit it to make a multi-million dollar investment and then deny it a license to operate. As the Interveners see the problem, issuance of the license is automatic—virtually a ministerial act—once the construction permit has been issued.

The Commission certainly does not so interpret the Act or its regulations. Perhaps it may be argued that in the case of types of reactors which have become virtually production line-items, such as certain relatively small research reactors of standard types, nothing short of a wholly unanticipated event of major significance would cause the Commission to withhold an operating license to a purchaser after issuance of a construction permit. In the case of the PRDC reactor design, however, PRDC has been on notice since before the first shovel of dirt was moved that its construction permit is provisional upon further demonstration of many technological facts, including the complete safety of the reactor. The Applicant has, in fact, stated on the record that it is going to proceed at first under only the [fol. 6864] construction permit so as to develop a background that will support reasonable assurance that the reactor can be operated in complete safety, and has stated its intention to seek operating authority only after all necessary facts have been assembled. Since PRDC has recognized the experimental nature of the reactor it is building and since it has expressly waived any commitment (if there exists any of the type that the Interveners contend is implied by the construction permit), for an operating license, the possibility that the Commission would be in any way bound cannot be visualized. It would be hard to imagine a case where an applicant would be less able to argue that he had been misled by previous favorable Commission action. Under the circumstances of this case, moreover, and in view of the wording of the provisional construction permit,

it must be perfectly clear that PRDC is assuming a substantial financial risk with its eyes wide open, and that the generation of any pressure from such ingredients would be quite absurd. An operating license may be considered in light of the clear wording of the statute and on the basis of the legislative history, as a logical, but not automatic, sequel to the fulfillment of the conditions of the construction permit, but we emphasize in this decision the importance of the present construction permit provisions requiring the demonstration of safety and of satisfying those conditions.

Several problems having a relationship to the operational safety of the reactor must be kept in mind. First there is the possible instability of the reactor, second is the possibility of a fuel element melt-down and its reassembly into a critical mass of dangerous proportions; third is the possible damage resulting from the leak of radioactive fission products in the event of a rupture of the steel contain- [fol. 6865] ment shell of the reactor as a result of one of the previously described accidents of some other.

First of all the Commission must agree that the possibility of one of these accidents—or some other—cannot be categorically excluded. If the statute and the regulations are to be interpreted, as the Intervenors imply, so that the Commission must be *certain* that such an accident will never occur, then no licensed reactor could ever be built. The very fact that Section 104, under which developmental reactors can be licensed, is in the statute reveals that such a standard was never contemplated, and the concept of reasonable assurance of safety must be sensibly, though severly applied.

The spectrum of expert testimony on the safety of the proposed PRDC design was surprisingly narrow. The report of the Reactor Safeguards Committee referred to in Intervenors' brief can be literally accepted by the Commission, as it was by many of the witnesses, as meaning that the state of human knowledge at the time the report was prepared would not support an absolute guarantee that there would be no safety problem in the operation of the reactor; but it also permits the conclusion that going forward with the construction phase of this project would, by the very nature of the information developed in the course

of evolving design, help to remove doubt concerning safety and would tend to provide an increasingly firm foundation for the reasonable assurance required by the statute that the project could be *operated* without undue risk to public health and safety. Of one thing there can be certainty: until the questions raised by the Reactor Safeguards Committee have been answered, to the satisfaction of the Commission, there will be no license to operate the PRDC reactor.

[fol. 6866] It is in the nature of reactor design, although certainly not unique to it, that many features remain to be designed and demonstrated after construction is begun—and, indeed, some features redesigned and replaced after operation is under way—but the Commission foresees the solution of such problems as still remain. Certainly there is nothing in the design as presently contemplated that is known to be inherently and immediately dangerous, and no insoluble problems are presently identified.

It is enough for the purposes of the present proceeding, that is for provisional construction permit purposes, and for satisfaction of the requirements of the statute and the regulations, that there be reasonable assurance that the reactor can eventually be operated safely. We conclude that the present state of knowledge as described in the record give that assurance and that the accident possibilities considered on the record do not negate that assurance; on the contrary, we anticipate that the growth of present knowledge within a time reasonable in relation to the production schedule will continue to strengthen it.

The question of safety, however, obviously cannot be considered without regard to proposed location. Just as the concept of reasonable speed on a flat and straight stretch of a transcontinental highway is quite different from reasonable speed on a mountain road or a city street, so also the operation of a reactor at Lagoona Beach, Michigan cannot be equated to operation of one at the National Reactor Testing Station in Idaho.

We are satisfied on the basis of the record that the likelihood of any breach of the containment shell which PRDC proposes, designed as it is to contain an explosive force equivalent to 600 pounds of TNT, a limit beyond any known

[fol. 6867] accident possibility in the reactor, is extremely remote, but the possible consequences in the event of such a rupture should still not be ignored. If the containment structure failed to hold the fission products of the reactor as a result of a nuclear accident, the consequences would depend on the meteorological conditions at the moment as well as upon the nature of the fission products released. This problem is not unique to either the PRDC reactor or to fast breeders in general; rather it applies to all types of reactors.

With regard to location, however, the record shows that the Applicant is well aware of its problem and is attempting to take all reasonable steps not only to prevent accidents but also to curtail the consequences of an accident if there should be one. Studies of weather, hydrology, geology, etc., have yielded considerable information, and are still in progress. That the data of these types are not complete or conclusive may readily be agreed, but such data as are available in the record tend to support the finding that there is nothing peculiar to the proposed location that negates a conclusion that reasonable assurance of the safe operation of the reactor will be as likely in that location as elsewhere. The record gives reasonable assurance to that effect, and we anticipate that knowledge to be acquired will fortify it.

In the case of the proposed site of the reactor, as in the case of the inherent safety of the proposed reactor itself, we emphasize that the degree of certitude that satisfies us for purposes of the provisional construction permit would not be the same as we would require if we were at this [fol. 6868] moment considering the issuance of the operating license. "Reasonable assurance" can be a different standard for the one purpose from what it is for the other. Even the Interveners on oral argument seemed to acknowledge the differing degrees of certitude that the two situations would require, and we think that the form of our order adequately protects all participants in this proceeding, as well as the public as a whole, in its manner of providing for the distribution of new information that is expected to be useful when the time arrives for consideration of an operating license.

The financial qualification of an Applicant is by the Commission's regulations made an explicit condition of the issuance of the license. The requirement is stated in Regulation 50.40 (b) quoted above, and it is repeated in connection with the treatment of allocation of special nuclear materials in Regulation 50.60 (b):

> "The request for incorporation of [provisions designating quantities of special nuclear material available for use by the facility] may be made simultaneously with the submission of an application for construction permit of facility license or at any time thereafter. Such request should be accompanied by at least the following information:
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> (1) The applicant's financial qualifications to assume responsibility for payment of Commission charges for the materials, and to undertake and carry out the proposed use of special nuclear material for a reasonable period of time;
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> * * *
>
> [fol. 6869] (c) A request for the incorporation in a construction permit or license of provisions designating the amount of special material available for use by the facility will be approved by the Commission if:
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> * * *
>
> (2) The applicant appears to be financially qualified to assume responsibility for the payment of Commission charges for the material and to undertake and carry out the proposed use of special nuclear material for a reasonable period of time;
>
> * * *"

There is a substantial amount of evidence in the record concerning the financial history and prospects of PRDC and its members. We have already noted that public utilities and equipment manufacturers of financial position, having among them, in fact, a gross equity of about two billion dollars, are included among those members, and they have contributed upon call some $23 million to PRDC.

So far as the record shows, funds have been forthcoming from the members of PRDC on call, and there is no evidence to indicate this willingness to continue to support PRDC will cease. PRDC appears to be paying its bills, and its credit has not been indicated to be questionable.

It appears in the record that the utilities which have contributed to PRDC have so far had their payments allowed by the commissions regulating them in their respective States as proper expenditures. In addition, the availability to PRDC of a $15 million loan with a New York bank appears firm. All in all the record shows that PRDC has assets available to it of nearly $49,500,000, and this sum seems to be substantial evidence upon which to base a conclusion [fol. 6870] of financial responsibility. Present estimates of the cost of the reactor are in the neighborhood of $34 million, and one may estimate that research and development expenses, administrative expense, interest during the construction period, start-up, and other miscellaneous items will add about $8 million to that figure.

The Interveners contended that a good many of the items included in the total cost of the reactor had been underestimated, and that therefore the total was grossly underestimated. We agree that the experience with reactors has been such that cost estimates have customarily been exceeded, and we are prepared to agree that many items will cost more than applicant has estimated—but probably not as much more as Interveners contend. Likewise we are prepared to agree that the applicant has over-estimated the revenues it is likely to receive from the sale of plutonium. It appears to us, however, that the financial history of PRDC and the financial standing of its members are such that the increases in cost feared by the Interveners will be covered through the devices that PRDC has previously utilized.

The Commission's regulations obviously do not require an applicant to have cash on hand to cover all possible contingencies of costs higher and revenues lower than estimates. Cash on hand or in the bank is certainly prime evidence of financial responsibility but it is clearly not the only evidence. On the basis of the financial estimates in the record, and even after making allowances for reasonable

cost over-runs, and revenue under-runs, such as will probably be the product of plutonium prices lower than estimated by PRDC, we are satisfied that the prima facie showing and the reasonable probability of financial qualification [fol. 6871] to construct and operate the proposed reactor, to receive an allocation of nuclear materials and to pay Commission charges and prices therefor for at least a reasonable time after scheduled start-up of the reactor has not been rebutted. The Intervener's argument and the Applicant's not too strenuous disagreement that the project is likely to be a financial failure for the PRDC membership does not refute it within the framework of the issues of this proceeding.

We find no need to discuss or to pass upon the question of exemption from the Commission's regulations.

The argument of the Interveners to the effect that the ruling of the Examiner permitting the introduction of direct testimony in the form of written narrative was error is without merit. While there may be substantial division of opinion among members of the Bar concerning the practice of presenting direct testimony by written narrative rather than orally, nevertheless, the practice is so well established in administrative proceedings as to admit no doubt of its validity.

The contention of the Interveners that they were denied a fair hearing because certain consultants of the Commission who intended to appear as witnesses were advised of the existence of conflict of interest laws is without merit. The letter to the consultants was in no way characterized by duress; rather it merely alerted those consultants in a very tactful way to the possible desirability of consulting their own counsel. The consultants were free to act, and the choice of whether or not to do so was completely their [fol. 6872] The objections of the Interveners to the participation of former Chairman Lewis L. Strauss in the decision and their motion to disqualify him became moot when Mr. Strauss' term as a Commissioner expired on June 30, 1958.

The Interveners' contention that they were denied a fair hearing because they did not have access to Restricted Data and refused to follow the normal clearance procedures is

likewise without merit. The Interveners showed no proof of prejudice or injury, and the legal duty of the Commission to classify certain material as Restricted Data and to establish a system for access to it is readily apparent from the Atomic Energy Act.

The Commission has considered all the other points raised by the Interveners in their briefs and an oral argument and finds them without merit.

The remaining part of the Opinion and Initial Decision of the Commission of December 10, 1958, including numbered findings concurring opinion of Commissioner Graham, order and construction permit as amended, are printed at pages 607-29 of Volume II of the printed record.

[fol. 6909]

BEFORE THE ATOMIC ENERGY COMMISSION

Docket No. F-16

In the Matter of

POWER REACTOR DEVELOPMENT COMPANY

INTERVENORS' EXCEPTIONS TO OPINION AND INITIAL DECISION, WITH SUPPORTING BRIEF

Benjamin C. Sigal, 1126 Sixteenth Street, N.W., Washington 6, D.C., Attorney for Intervenors.

Of Counsel: Harold A. Cranefield, Lowell Goerlich.

January 14, 1959.

[fol. 6910]

UNITED STATES OF AMERICA

ATOMIC ENERGY COMMISSION

Docket No. F-16

In the Matter of

POWER REACTOR DEVELOPMENT COMPANY

INTERVENORS' EXCEPTIONS TO THE OPINION AND INITIAL DECISION OF THE ATOMIC ENERGY COMMISSION

The Commission erred in making the following findings and conclusions:

1. That the rules of the Commission are designed to provide for Commission determination of the form and scope of a construction permit as appropriate in a particular case, depending upon the particular state of research and development currently applicable to the proposed project (Op., p. 14).[1]

2. That the Intervenors interpreted the statute and regulations to the effect that all the same findings as the Commission would have to make in order to issue a license must also be made in order to issue a construction permit, and the distinction between the construction permit and the license is only in the name (Op., p. 16).

3. That since PRDC has recognized the experimental nature of the reactor it is building and since it has expressly waived any commitment for an operating license which may be implied from the issuance of the construction [fol. 6911] permit, the possibility that the Commission would be in any way bound cannot be visualized . . . An operating license may be considered in the light of the clear wording of the statute and the basis of the legislative history, as a logical, but not automatic sequel to the ful-

[1] References in this form are to page numbers of the Opinion and Initial Decision.

fillment of the conditions of the construction permit . . . (Op., p. 19).

4. That the Intervenors imply that the Commission must be *certain* that an accident will never occur before a license may be issued (Op., p. 20).

5. That the report of the Reactor Safeguards Committee means that the state of human knowledge at the time the report was prepared would not support an *absolute* guarantee that there would be no safety problem in the operation of the reactor, but it also permits the conclusion that going forward with the construction phase of this project would, by the very nature of the information developed in the course of evolving design, help to remove doubt concerning safety and would tend to provide an increasingly firm foundation for the reasonable assurance required by the statute that the project would be *operated* without undue risk to the public health and safety (Op., p. 20).

6. That it is enough for the purposes of the provisional construction permit, and for the satisfaction of the requirements of the statute and regulations, that there be reasonable assurance that the reactor can eventually be operated safely (Op., p. 21).

7. That in the case of the proposed site of the reactor, the degree of certitude that satisfies the Commission for purposes of the provisional construction permit would not be the same as would be required if the Commission were now considering the issuance of the operating license (Op., p. 22).

[fol. 6912] 8. That the Intervenors on oral argument seemed to acknowledge the differing degrees of certitude which the two situations would require (Op., p. 23).

9. Funds have been forthcoming from the members of PRDC on call and there is no evidence to indicate this willingness to continue to support PRDC will cease (Op., p. 24) (T. 346, 508, 509).[2]

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[2] References in this form are to pages of the record supporting the exception.

10. That while the Commission agrees that the experience with reactors has been such that cost estimates have customarily been exceeded, and is prepared to agree that many items will cost more than PRDC estimated, and is prepared to agree, further, that PRDC has overestimated the revenues it is likely to receive from the sale of plutonium, nevertheless the financial history of PRDC and the financial standing of its members are such that increases in cost feared by the Intervenors will be covered by the devices that PRDC has previously utilized (Op., p. 25) (T. 3434, 3435, 3438, 792, 794).

11. That the objection of the Intervenors to the ruling of the Examiner permitting the introduction of direct testimony in the form of written narrative is without merit (Op., p. 26).

12. That the contention of the Intervenors that they were denied a fair hearing because certain consultants of the Commission who intended to appear as witnesses were advised of the conflict of interest laws is without merit (Op., p. 26).

13. The Intervenors' contention that they were denied a fair hearing because they did not have access to restricted [fol. 6913] data because they refused to follow the normal clearance procedures is without merit (Op., p. 27).

14. That the operations of PRDC will, if conducted according to the construction permit issued by the Commission on August 4, 1956, be subject to the Atomic Energy Act of 1954, as amended, and the Rules and Regulations issued by the Commission (No. 1).

15. That there is no inherent hazard and danger to the health and safety of the public in the operation of fast breeder reactors (No. 5) (T. 2937, 3129, 3130).

16. That reactors using sodium as coolant have operated successfully and have demonstrated the ability to achieve satisfactory purity of sodium and to avoid significant corrosion (No. 9).

17. That the proposed experiments with EBR I, Mark III cor[illegible] are expected, if properly carried out, definitively

to establish the correctness or incorrectness of the bowing hypotheses as the cause of the positive temperature coefficient observed in EBR I (No. 11).

18. That although many questions remain to be answered regarding the problem of meltdown and disassembly or reassembly of the core or a substantial portion thereof, the existence of these problems does not negate the likelihood that they will be answered in due course; and in time for the answers to precede any decision of the Commission with regard to an operating license for the proposed PRDC reactor (No. 15) (T. 2040, 2952, 2953, 3131, 2927, 3102, 3103, 3132).

19. That the necessity for constructing a prototype of the proposed reactor at a remote location has not been shown, but if the program of meltdown investigation should prove inconclusive it will be necessary to reconsider the question of need for a prototype (No. 17).

[fol. 691] 20. That there is reasonable assurance that theoretical and experimental investigations which have been undertaken, together with operating experience at one or more of the EBR I, EBR II and Dounreay reactors, will establish definitively, prior to the scheduled completion date of the PRDC reactor, whether or not the reactor proposed by PRDC can be so operated; it is probable that evidence will establish that the reactor proposed by PRDC can be so operated (No. 18) (T. 2999, 3109, 3111, 3130).

21. That design modifications required by the results of studies of the meteorology, lake currents, air diffusion, flooding, and other problems can be considered at the time that the question of a license to operate is before the Commission (No. 20) (T. 3340, 3341).

22. That the suitability of the site for the proposed reactor depends upon the inherent safety of the reactor and the demonstration that no credible accident can release significant quantities of fission products into the atmosphere. If these are established, and there is reasonable assurance that they can be, it is probable that the site will prove suitable for the proposed reactor, but a definitive

evaluation of the suitability of the proposed site cannot be made at the present time (No. 21).

23. That the Commission finds reasonable assurance in the record that a utilization facility of the general type proposed in the PRDC application and the amendments thereto can be constructed and will be able to be operated at the location proposed without undue risk to the health and safety of the public (No. 22).

[fol. 6915] 24. That the member companies of PRDC should provide additional funds, if necessary, to take care of adverse contingencies during construction and test operation of the proposed reactor (No. 23) (T. 346, 508, 509).

25. That the record does not demonstrate that a cost over-run on construction and research and development will exceed PRDC's available assets by any amount and especially by an amount large enough to disprove PRDC's financial qualifications (No. 24) (T. 3407, 3408, 3473, 336-338; 3287-3326).

26. That PRDC expects to cover any loss of special nuclear material resulting from an accident by insurance, application of unencumbered assets or a guarantee from its sponsors, and has, therefore, shown a reasonable probability of being able to pay Commission charges for loss of special nuclear material through 1963 (No. 25) (T. 792-794).

27. That while data presently available indicate that a reactor of the general type described in the Application can be so designed that no credible accident in the course of its operation is likely to result in the release of significant quantities of fission products into the atmosphere, this conclusion has not been demonstrated sufficiently at this time to justify issuance of an operating license (No. 30) (T. 2933, 3118; Benedict-Narr. T. 8, 10-12).

28. That theoretical and experimental programs now under way should establish the foregoing conclusion sufficiently to justify issuance of an operating license. Results of these programs should be available prior to the time it should be necessary for the Commission to rule on the oper-

ating aspect of the license application (No. 31) (T. 3130, 2999, 3269, 3270, 3083).

[fol. 6916] 29. That the proposed site is generally suitable for a reactor of the type and size described in the Application, if the reactor is otherwise shown to be capable of operation without undue hazard, including demonstrations of stability and adequate containment (No. 32) (Wolman, Narr. 13, 15, 16, 17, 20; T. 3340, 3341).

30. That there is reasonable assurance that technical information omitted from the Application and required to complete it will be supplied prior to the time when it is necessary for the Commission to rule on the license application itself (No. 33) (T. 2040, 2927, 2952, 3102-3, 3109, 3111, 3132).

31. That PRDC is financially qualified to engage in construction and operation of the reactor described in the Application and to receive the allocation of special nuclear material therefor (No. 34).

32. That the issuance of construction permit will not be inimical to the common defense and security or to the health and safety of the public (No. 35).

33. The Commission erred in failing to make any findings with respect to the legality of the issuance of the conditional construction permit on August 4, 1956. The Commission erred, specifically, in failing to find:

a. That on August 4, 1956, the Commission did not have sufficient information to provide reasonable assurance that a facility of the general type proposed could be constructed and operated at Lagoona Beach, Michigan without undue risk to the health and safety of the public;

b. That on August 4, 1956, the Commission did not have sufficient information to provide reasonable assurance that the technical information omitted from and required to complete PRDC's application for a license would be supplied;

[fol. 6917] c. That on August 4, 1956, PRDC was not financially qualified to engage in the proposed activities in accordance with the Commission's regulations.

d. That on August 4, 1956, PRDC was not financially qualified to assume responsibility for payment of Commission charges for material and to undertake and carry out the proposed use for the material for a reasonable time.

The Commission erred, further, in finding:

34. That there is no merit in the contention of the Intervenors that the Commission denied them a fair hearing by limiting the issues in the proceedings so as to preclude proof that issuance of a conditional construction permit to PRDC on August 4, 1956 was illegal (p. 27).

35. That there is no merit in the contention of the Intervenors that they were denied a fair hearing as a result of the Hearing Examiner's refusal to require AEC to state its position on the issues specified by the Commission (p. 27).

The Order, dated December 10, 1958, is erroneous (p. 42).

The page references to the record following various exceptions above indicate testimony which contradicts the findings referred to in said exceptions. Exceptions which are not followed by references to the record are based on provisions of the Act and Commission regulations adopted pursuant thereto, particularly Sections 185 and 189 (a) of the Act, and Sections 2.740, 50.30 to 50.38, 50.40, 50.45, 50.50, 50.55, and 50.60 (b) and (c) of the Commission's regulations; Section 7(a) of the Administrative Procedure Act; and the First and Fifth Amendments to the Constitution of the United States.

Respectfully submitted,

Benjamin C. Sigal, Attorney for Intervenors.

Of Counsel: Harold A. Cranefield, Lowell Goerlich.

[fol. 6918] [File endorsement omitted]

IN UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

No. 15,271

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL-CIO; UNITED AUTOMOBILE, AIRCRAFT AND AGRICULTURAL IMPLEMENT WORKERS OF AMERICA; and UNITED PAPERMAKERS AND PAPERWORKERS, Petitioners,

v.

UNITED STATES OF AMERICA, Respondent.

AMENDED PETITION FOR REVIEW OF AN ORDER OF THE ATOMIC ENERGY COMMISSION—Filed July 27, 1959

To the Honorable, the Judges of the United States Court of Appeals for the District of Columbia Circuit:

International Union of Electrical, Radio and Machine Workers, AFL-CIO; United Automobile, Aircraft and Agricultural Implement Workers of America; and United Papermakers and Paperworkers, Petitioners, respectfully petition this Court, pursuant to Atomic Energy Act of 1954, 68 Stat. 919, Section 189, Act of December 29, 1950, as amended, ch. 1189, 64 Stat. 1129, and Administrative Procedure Act, Section 10, as amended, 60 Stat. 243, to review an order of Atomic Energy Commission, hereinafter called Commission, affirming and continuing in effect, with certain modifications, a construction permit issued to Power Reactor Development Company for construction of an atomic power reactor. The proceeding resulting in said order is designated upon the records of the Commission as Matter of Power Reactor Development Company, Docket No. F-16.

1. A conditional construction permit was issued to Power Reactor Development Company by the Commission on

August 4, 1956, and the Petitioners intervened in this proceeding on August 31, 1956, alleging that the Commission had, by issuing said conditional construction permit, violated the Atomic Energy Act of 1954, 68 Stat. 919, *et seq.* and the Commission's regulations adopted pursuant thereto. Petitioners requested the Commission to suspend the permit pending a final determination of the proceedings, and on final order to rescind and declare a nullity said permit until such time as there had been full compliance by Power Reactor Development Company with all pertinent provisions of the Act and the Commission's regulations.

[fol. 6919] 2. After due proceedings before the Commission, the Commission issued its Opinion and Final Decision on May 26, 1959, affirming and continuing said construction permit, with certain modifications. A copy of said Opinion and Final Decision is attached hereto.

3. The findings and order of the Commission are not supported by substantial evidence on the record considered as a whole, and are contrary to applicable law, including Commission regulations.

4. This Court has jurisdiction of this petition, which is brought by parties aggrieved by the final order of the Commission, under the provisions of the Act of December 29, 1950, ch. 1189, Sections 3 and 4, 64 Stat. 1130.

Wherefore, the Petitioners pray that the Court take jurisdiction of this proceeding and of the questions determined therein, review the final order of the Commission, and make and enter, upon the basis of the record, a decree setting aside the order of the Commission.

Respectfully submitted,

Benjamin C. Sigal, Attorney for Petitioners.

July 25, 1959.

[fol. 6920] [File endorsement omitted]

IN UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

[Title omitted]

ORDER ALLOWING INTERVENTION OF POWER REACTOR DEVELOPMENT COMPANY—August 24, 1959

Upon consideration of the motion of Power Reactor Development Company for leave to intervene in this case, and it appearing that no objections have been filed, it is

Ordered by the court that Power Reactor Development Company is allowed to intervene in this case.

Per Curiam.

Dated: August 24, 1959.

[fol. 6921] [File endorsement omitted]

IN UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

[Title omitted]

ORDER ALLOWING INTERVENTION OF STATE OF MICHIGAN—October 30, 1959

Upon consideration of the motion of the State of Michigan for leave to intervene as a party respondent in this case, and it appearing that no objections have been filed, it is

Ordered by the court that the State of Michigan is allowed to intervene in this case.

Per Curiam.

Dated: October 30, 1959.

[fol. 6922] [File endorsement omitted]

IN UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

[Title omitted]

STATEMENT OF ISSUES OF INTERVENOR POWER REACTOR DEVELOPMENT COMPANY—Filed November 14, 1959

Pursuant to the Orders of the Court herein dated October 22 and November 6, 1959, Intervenor Power Reactor Development Company herewith files the following statement of the issues which it desires to present:

1. Whether the order of the Atomic Energy Commission of May 26, 1959, continuing in effect the provisional construction permit of the Intervenor Power Reactor Development Company and providing procedure for continuing review of this project by the Commission and for a further hearing and determination with respect to both safety of operation of the proposed reactor and the financial qualification of the applicant, prior to issuance of any operating license, is a final order which aggrieves the Petitioners or otherwise so affects their rights as to make such order now reviewable at their instance, under the provisions of Section 189 of the Atomic Energy Act of 1954 as amended (42 U.S.C. §2239), the Judicial Review Act of December 29, 1950, as amended (5 U.S.C. §1031-42), and Section 10 of the Administrative Procedure Act (5 U.S.C. §1009).

[fol. 6923] 2. Whether the first, fourth and sixth numbered issues included in "Petitioners Statement of the Issues", filed with this Court November 3, 1959, are moot or otherwise not properly presented by the decision of the Atomic Energy Commission sought to be reviewed herein.

3. Whether the second, third and eighth numbered issues included in "Petitioners Statement of the Issues", filed with this Court November 3, 1959, are properly presented by the decision of the Atomic Energy Commission sought to be reviewed herein.

In accordance with Rule 17(c) of the Rules of this Court, Intervenor Power Reactor Development Company further reserves the right to present in its brief a counter-statement of the questions presented in a form other than that in which such questions are stated and argued in the brief to be submitted by Petitioners.

Respectfully submitted,

W. Graham Claytor, Jr., Attorney for Intervenor, Power Reactor Development Company.

Covington & Burling, Washington, D. C.; Miller, Canfield, Paddock and Stone, Detroit, Michigan, Of Counsel.

Dated: November 13, 1959.

[fol. 6924] Certificate of Service (omitted in printing).

[fol. 6925] [File endorsement omitted]

In United States Court of Appeals

For the District of Columbia Circuit

[Title omitted]

Statement of Issues for the Respondents—
Filed November 13, 1959

Pursuant to the order of this Court dated October 22, 1959, respondents have examined the statements of issues tendered by the petitioners and the intervenor, Power Reactor Development Company. Respondents have determined that they do not desire to present any further issues in addition to those already stated by the petitioners and intervenor.

Respondents reserve the right to set forth in their brief in this case a "Statement of Questions Presented", pur-

suant to Rule 17(c)(1) of the Rules of this Court, in a form other than stated by petitioners and intervenor.

Respectfully submitted,

Samuel D. Slade, Lionel Kestenbaum, Department of Justice, Washington 25, D.C., Attorneys for Respondents.

Loren K. Olson, General Counsel, Atomic Energy Commission, Washington 25, D.C.

[fol. 6926] CERTIFICATE OF SERVICE (omitted in printing).

[fol. 6927] [File endorsement omitted]

IN UNITED STATES COURT OF APPEALS

FOR THE DISTRICT OF COLUMBIA CIRCUIT

[Title omitted]

PETITIONERS' SUPPLEMENTARY STATEMENT OF THE ISSUES—Filed December 8, 1959

Pursuant to the Order of the Court herein, dated October 22, 1959, Petitioners herewith file a supplementary statement narrowing the issues, as follows:

1. Did the Commission violate the Atomic Energy Act of 1954, and its own regulations, by issuing a provisional construction permit to the Power Reactor Development Company, on August 4, 1956, without finding:

a) That there was information sufficient to provide reasonable assurance that a utilization facility of the general type proposed by the Company could be constructed and operated at the proposed site without undue risk to the health and safety of the public;

b) That there was reasonable assurance that technical information omitted from and required to complete the application would be supplied by the Company;

c) That the Company was financially qualified to engage in the proposed activities pursuant to Section 50.40 (b), Title 10 CFR; and

[fol. 6928] d) That the Company was financially qualified to receive an allocation of special nuclear material pursuant to Section 50.60 (c)(2), Title 10 CFR?

2. Did the Commission violate the Act, and its own regulations, by continuing in effect the construction permit issued to Power Reactor Development Company on the basis of a finding that there is reasonable assurance in the record, for the purposes of this provisional construction permit, that a utilization facility of the general type proposed by the Company can be constructed and operated without undue risk to the health and safety of the public?

3. Did the Commission violate the Act, and its regulations, by continuing in effect the construction permit issued to Power Reactor Development Company without a finding that, as of the date of said Decision and Order, there was information sufficient to provide reasonable assurance that a utilization facility of the general type proposed by the Company can be constructed and operated at the proposed site without undue risk to the health and safety of the public?

4. Did the Commission violate the Act, and its own regulations, by continuing in effect the construction permit issued to Power Reactor Development Company on the basis, *inter alia*, that for the purposes of a provisional construction permit, there is reasonable assurance that the Company is financially qualified to engage in the construction and operation of the reactor described in the PRDC application and to receive the allocation of special nuclear material therefor?

5. Is the finding of the Commission that, for the purposes of a provisional construction permit, there is reasonable assurance that the Power Reactor Development Company is financially qualified to engage in the construction and operation of the reactor described in its application, and to receive the allocation of nuclear material there-

for, supported by substantial evidence on the record considered as a whole?

[fol. 6929] 6. Did the Commission violate the Act, and its own regulations, by continuing in effect the construction permit issued to Power Reactor Development Company without finding that said Intervenor is financially qualified to engage in construction and operation of the reactor described in said Intervenor's application, and to receive an allocation of special nuclear material therefor?

Respectfully submitted,

Benjamin C. Sigal, 1126 Sixteenth Street, N. W., Washington 6, D. C., Attorney for Petitioners.

December 8, 1959

[fol. 6930] Certificate of Service (omitted in printing).

[fol. 6931] [File endorsement omitted]

In United States Court of Appeals

For the District of Columbia Circuit

No. 15271

International Union of Electrical, Radio and Machine Workers, AFL-CIO; United Automobile, Aircraft and Agricultural Implement Workers of America; and United Papermakers and Paperworkers, Petitioners,

—v.—

United States of America and Atomic Energy Commission, Respondents,

Power Reactor Development Company, State of Michigan, Intervenors.

On Petition to Review an Order of the Atomic Energy Commission

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Mr. Benjamin C. Sigal for petitioners.

Mr. Lionel Kestenbaum, Attorney, Atomic Energy Commission, with whom Assistant Attorney General Doub, Messrs. Loren K. Olson, General Counsel, Atomic Energy Commission, Courts Oulahan, Special Assistant to the General Counsel, Atomic Energy Commission, and Samuel D. Slade, Attorney, Department of Justice, were on the brief, for respondents.

[fol. 6932] Mr. W. Graham Claytor, Jr., with whom Mr. John Lord O'Brian was on the brief, for intervenor Power Reactor Development Company.

Mr. Jerome Maslowski entered an appearance for intervenor State of Michigan.

Before: EDGERTON, BAZELON, and BURGER, Circuit Judges.

EDGERTON, Circuit Judge:

Petitioners seek review of the Atomic Energy Commission's Order of May 26, 1959 which continued in effect, with amendments, a "provisional" construction permit issued August 4, 1956, for a nuclear power reactor. Section 104b of the Atomic Energy Act of 1954 authorizes the Commission to issue licenses for "utilization and production facilities involved in the conduct of research and development activities leading to the demonstration of the practical value of such facilities for industrial or commercial purposes. In issuing licenses under this subsection, the Commission shall impose the minimum amount of such regulations and terms of license as will permit the Commission to fulfill its obligations under this Act to promote the common defense and security and to protect the health and safety of the public . . . ." 68 Stat. 937, 42 U.S.C. §2134(b).

The holder of the construction permit, intervenor here, is the Power Reactor Development Company (PRDC), a Michigan membership corporation organized "to study, develop, design, fabricate, construct and operate one or more experimental nuclear power reactors . . . to the

end that there may be an early demonstration of the practical and economical use of nuclear energy for the generation of electrical energy . . . ." Of PRDC's 21 members, 14 are public utilities and 7 are equipment manufacturers.

The reactor will be the largest, but not the first, "fast breeder" reactor in the United States. The site is at Lagoona Beach, Monroe County, Michigan, on the shore of Lake Erie, 30 miles southwest of Detroit.

[fol. 6933] We cannot review the Commission's order at petitioners' request unless (1) it is a "final order" and (2) petitioners are "aggrieved" by it. Atomic Energy Act of 1954, § 189, 42 U.S.C. § 2239(b); 5 U.S.C. §§ 1032, 1034. Although the Commission's action of May 26, 1959 was entitled "Commission's Opinion, Final Decision and Order," the Commission and PRDC now contend that the order was not final. They also contend that it did not aggrieve the petitioners. In our opinion it was what it purported to be, a final order, and petitioners are "aggrieved" by it. Because it threatens them with economic injury, they "had the requisite standing to appeal and to raise . . . any relevant question of law in respect of the order . . ." *Federal Communications Commission* v. *Sanders Brothers Radio Station*, 309 U.S. 470, 477.

Petitioners are national or international labor unions which intervened, with some of their members, in the proceedings before the Commission, on the basis that "granting the conditional construction permit herein (1) is a violation of the provisions of the Atomic Energy Act of 1954, and the regulations pursuant thereto adopted by the Commission . . . and (2) will result in the construction of a reactor which, under present technological conditions, is inherently unsafe, and which will thereby create a hazard which will place the individual Intervenors, the members of the UAW and their families, and the UAW in danger of an explosion or other incident" damaging to the individuals and their homes, real estate values, and employment; that the value of collective bargaining contracts "will be seriously impaired if the PRDC reactor is built in this area without reasonable assurances of safety"; and that there are "reasonable grounds for

belief that a license to operate said facility when it is completed, with an expenditure of $45,000,000 will be issued without proper consideration of and regard for the health and safety of the public."

[fol. 6934] In their reply brief in this court, petitioners contend that "The fear of a possible atomic catastrophe, in itself, before any operation would begin, would; among other things have the effect of depressing values of property owned by the Petitioners, and would cause plants in which they work under collective bargaining agreements to move and thereby cause a loss of employment." Their reply brief asserts that "the uncontroverted allegations of their petition for intervention before the Commission set forth the economic injury they would suffer merely from the construction of the reactor itself." But we find no such allegations in their petition for intervention before the Commission. The theory of that petition was that construction would cause operation, and operation would cause injury, not that construction without operation would cause injury.[1] Judicial review is limited to the record before the Commission. 5 U.S.C. § 1037(a).

As the Commission says in its order, "a construction permit is a step toward a license rather than the equivalent thereof. . . . This permit is provisional to the extent that a license authorizing operation of the facility will not be issued by the Commission unless PRDC has submitted to the Commission (by proposed amendment to the Application) the complete, final Hazards Summary Report (portions of which may be submitted and evaluated from time to time), and the Commission has found that the final design provides reasonable assurance that the health and safety of the public will not be endangered by operation of the facility in accordance with the specified procedures. It is further provisional to the extent that the Commission reserves jurisdiction, at any time prior to issuance of an operating license, upon notice to the parties herein, to reopen this proceeding for the purpose of receiving additional evidence, and to make such

[1] It is undisputed that construction without operation will cause no *physical* injury or danger not involved in the erection of any large building.

[fol. 6935] determinations and take such action with respect to the continuance, vacation, or modification of this permit as the entire record warrants." But the order also says: "There is reasonable assurance that theoretical and experimental programs under way will develop sufficient data to justify the issuance of an operating license, and that the results of these programs will be available prior to the time it is necessary for the Commission to rule on the operating aspect of the PRDC license Application." PRDC says "it must be taken as settled . . . that the further technical information needed to complete the PRDC application for license will be supplied." Although this positive prediction overstates the matter, it is plainly probable, in a high degree, that if the construction permit stands PRDC will get an operating license and will operate. We think petitioners are therefore aggrieved by the issuance of the permit.

Safety findings required by the Atomic Energy Act

Petitioners contend that "The Act and the regulations of the Commission . . . require, as conditions precedent to the issuance of every construction permit for an atomic energy power reactor, that *as of the time the construction permit is issued* the Commission find that (1) it has reasonable assurance that the reactor may be constructed *and operated* at the proposed site without undue risk to the health and safety of the public . . . ."

It is undisputed that the Commission must make such a finding when it authorizes operation. The question is whether it must make such a finding when it authorizes construction. In our opinion it must.

Section 182 of the Atomic Energy Act of 1954, which is headed "License applications", provides in paragraph (a): ". . . In connection with applications for licenses to operate production or utilization facilities, the applicant shall state such technical specifications, including . . . the place of the use . . . and such other information as [fol. 6936] the Commission may, by rule or regulation, deem necessary in order to enable it to find that the utilization or production of special nuclear material . . . will provide adequate protection to the health and safety of the pub-

lic. Such technical specifications shall be a part of any license issued. . . ." 42 U.S.C. § 2232(a).

It seems to be unquestioned that the phrase used in § 182, "adequate protection to the health and safety of the public", and the Commission's phrase, "without undue risk to the health and safety of the public", are substantially equivalent.

Section 185 of the Act, which is headed "Construction permits", provides: "All applicants for licenses to construct or modify production or utilization facilities shall, if the application is otherwise acceptable to the Commission, be initially granted a construction permit. . . . Upon the completion of the construction or modification of the facility, upon the filing of any additional information needed to bring the original application up to date, and upon finding that the facility authorized has been constructed and will operate in conformity with the application as amended and in conformity with the provisions of this chapter and of the rules and regulations of the Commission, and in the absence of any good cause being shown to the Commission why the granting of a license would not be in accordance with the provisions of this Act, the Commission shall thereupon issue a license to the applicant. For all other purposes of this Act a construction permit is deemed to be a 'license'." 42 U.S.C. § 2235.

While the bill was pending, Senator Humphrey proposed, and withdrew, an amendment which would have added after the word "license", at the end of § 185: " , and no construction permit shall be issued by the Commission until after the completion of the procedures established by Section 182 for the consideration of applications for licenses under this act." (100 Cong. Rec. 11566 [fol. 6937] (1954); Legislative History of the Atomic Energy Act of 1954, Vol. III, p. 3759; Vol. I, p. 733) He said: "*The purpose of the amendment* when it was prepared *was to make sure that the construction of a facility was not permitted prior to the authorization of a license*, because had that been done what it would have amounted to would be getting an investment of a substantial amount of capital, which surely would have been prejudicial in terms

of the Commission issuing the license. In other words, if the Commission had granted the construction permit for some form of nuclear reactor, and then the question of a license was not fully resolved, surely there would have been considerable pressure, and justifiably so, for the Commission to have authorized the license once it had authorized the permit for construction.

"The chairman of the committee tells me he has modified certain sections by the committee amendments to the bill, of which at that time I was not aware. *The chairman indicates to me that under the terms of the bill, as amended, the construction permit is equivalent to a license.* In other words, as I understand, under the bill a construction permit cannot be interpreted in any other way than being equal to or a part of the licensing procedure. Is that correct?" Senator Hickenlooper, the manager of the bill, replied: "The Senator is correct. The staff has worked on this matter. . . . A license and a construction permit are equivalent. . . . Therefore, we believe, and we assure the Senator, that *the amendment is not essential to the problem which he is attempting to reach.*" After some discussion of other sections of the bill, this colloquy occurred: "Mr. HUMPHREY. In other words, the revised sections on judicial review and on hearings and *the revised section 182 on license application all apply directly to construction permit?* Mr. HICKENLOOPER. *Yes.* Mr. HUMPHREY. *With that statement, Mr. President, I withdraw my amendment. The only purpose of the amendment was to clarify that* [fol. 6938] *section.* I am grateful to the chairman for having done it before the amendment was considered." (Emphasis added.) (100 Cong. Rec. 11566; Legislative History, Vol. III, p. 3759.)[2]

If, as this indicates, § 182 applies "directly to" construction permits, when the Commission issues a construction permit it must "find that the utilization or production of special nuclear material . . . will provide adequate

[2] The Commission apparently interprets this colloquy as concerning only the "procedural safeguards" of notice, hearings, and appeal. We cannot so understand it and cannot suppose the Senate so understood it.

protection to the health and safety of the public"; or, in the Commission's phrase, that the facility can be "operated at the location proposed without undue risk to the health and safety of the public."

The Joint Committee on Atomic Energy said in its report on the bill: "Section 185 permits the Commission to issue construction permits to applicants for a production or utilization facility, describes the terms of the construction permit, and requires the issuance of a license if the construction is carried out in accordance with the terms of the construction permit." (S.Rep.No. 1699, 83d Cong., 2d Sess., 28 (1954); Legislative History, Vol. I, p. 776.) It seems certain that if the Act did not require, as a condition to the issuance of a construction permit, a finding that the proposed facility can be operated without undue risk to the health and safety of the public, the Act would not require the issuance of a license when the permitted construction is carried out.

At the very least it is doubtful whether the Commission's construction of the Atomic Energy Act is correct. The possibilities of harm are so enormous that any doubt as to what findings the Act requires, and any doubt as to whether the Commission made such findings, should be resolved on the side of safety.

[fol. 6939] *The Commission's Safety Findings*

In our opinion the Commission's findings regarding safety of operation are not sufficient.

An Initial Decision dated December 10, 1958, contains this unqualified finding: "22. The Commission finds reasonable assurance in the record that a utilization facility of the general type proposed in the PRDC application and amendments thereto can be constructed, and will be able to be operated at the location proposed without undue risk to the health and safety of the public." But in the Opinion and Final Decision which accompanied its order of May 26, 1959, by interpolating the phrase we emphasize, the Commission qualified the finding: "22. The Commission finds reasonable assurance in the record, *for the purposes of this provisional construction permit*, that

a utilization facility of the general type proposed in the PRDC Application and amendments thereto can be constructed and operated at the location without undue risk to the health and safety of the public." (Emphasis added.) This is not a finding that a facility can be operated there without undue risk. It is a finding that there is sufficient likelihood that a facility can be operated there without undue risk so that, in the Commission's opinion, it is appropriate to issue a "provisional" construction permit. In our opinion such a finding does not meet the requirements of the Act.

The Commission made other statements which confirm the impression that it no longer found, as it had found in December, reasonable assurance that a facility can be operated at the location without undue risk. The Commission said: "The degree of 'reasonable assurance' with respect to safety that satisfies us in this case for purposes of the *provisional* construction permit would not be the same as we would require in considering the issuance of the *operating* license. . . . It has not been positively established that a fast breeder reactor of the general type and power level proposed by Applicant can be *oper-* [fol. 6940] *ated* without a credible possibility of releasing significant quantities of fission products to the environment . . . ." (Emphasis in original.) And again: "*For the purposes of a provisional construction permit*, there is reasonable assurance that a reactor of the general type described in the Application can be so designed that no credible accident in the course of its operation is likely to result in the release of significant quantities of fission products into the atmosphere." (Emphasis added.)

The Commission expressed confidence that future scientific developments would enable it, in the future, to find that the reactor could be operated without undue risk. It said: "There is reasonable assurance that theoretical and experimental programs under way will develop sufficient data to justify the issuance of an operating license, and that the results of these programs will be available prior to the time it is necessary for the Commission to rule on the operating aspect of the PRDC license Application." "There is reasonable assurance that theoretical

and experimental investigations which have been undertaken, together with operating experience on one or more of the EBR-I, EBR-II and Dounreay reactors, will establish definitively, prior to the scheduled completion date of the PRDC reactor, whether or not the reactor proposed by Applicant can be so operated"; *i.e.*, whether it can be "operated without a credible possibility of releasing significant quantities of fission products to the environment." Again, "there is reasonable assurance that *evidence will establish* that the reactor proposed by Applicant can be so operated." (Emphasis added.) This clearly implies that *evidence does not now establish* that the reactor can be so operated. The Commission's predictions regarding the future course of scientific development do not in our opinion satisfy the requirement of the Act.

The Commission said: "It is in the nature of reactor design, although certainly not unique to it, that many [fol. 6941] features remain to be designed and demonstrated after construction is begun—and indeed some features redesigned and replaced after operation is under way. . . . By proceeding with construction and further research and development simultaneously, rather than awaiting complete research and development results Applicant will save several years in the time required to place in operation its demonstration power reactor." As a matter of policy, there is force in these considerations. But Congress seems to have been more impressed by the opposite policy considerations to which Senator Humphrey, in his colloquy with Senator Hickenlooper, called the attention of the Senate. The economy cannot afford to invest enormous sums in the construction of an atomic reactor that will not be operated. If enormous sums are invested without assurance that the reactor can be operated with reasonable safety, pressure to permit operation without adequate assurance will be great and may be irresistible. PRDC's estimate of the cost of construction, preconstruction research and development, and administrative expenses during construction and test operation was $44,020,000. The Commission found there would probably be "a cost over-run".

In contrast with the Commission's repeated expressions of uncertainty, it used other expressions which might seem to indicate a positive opinion regarding safety of operation. The Opinion and Final Decision, before adverting to the issue of safety and other issues, said broadly: "we amplify and affirm our Opinion and Initial Decision dated December 10, 1958." The Commission also said: "The principal factual issue in this proceeding is whether there is information sufficient to provide a reasonable assurance that a utilization facility of the general type proposed in the PRDC application can be constructed and operated at the location proposed therein without undue risk to the health and safety of the public. Subsidiary to this issue is whether there is reasonable [fol. 6942] assurance that technical information omitted from, and required to complete, the application will be supplied before issuance of an operating license. A careful evaluation of the entire record in this proceeding can only lead to an affirmative answer to all of these questions." And again: "It is enough for the purposes of the present proceeding (that is, for the issuance of a provisional construction permit), and for the satisfaction of the requirements of the statute and the regulations, that there be reasonable assurance that the reactor can be constructed and operated without undue risk to the health and safety of the public. We conclude that the present state of knowledge as described in the record gives, and the accident possibilities presented on the record do not negate, that assurance."

It results that the Commission's findings regarding safety of operation are ambiguous. In view of the nature, size, and location of the project, we think the findings should be uncommonly free from ambiguity. The Commission should "make the basis of its action reasonably clear. We cannot find that it did so here." *Radio Station KFH Co.* v. *Federal Communications Commission*, 101 U.S.App.D.C. 164, 166, 247 F. 2d. 570, 572. "'We must know what a decision means before the duty becomes ours to say whether it is right or wrong.'" *Secretary of Agriculture* v. *United States*, 347 U.S. 645, 654.

Pacific Far East Line, Inc. v. *Federal Maritime Board*, —— U.S.App.D.C. ——, ——, 275 F. 2d 184, 187.

We think the Commission's safety findings are deficient in an additional respect.

In 1957 the Commission made to the Joint Committee on Atomic Energy "a report of a study of the possible consequences in terms of injury to persons and damage to property, if certain hypothetical major accidents should occur in a typical large nuclear power reactor." All the experts agreed "that the chances that major accidents might occur are exceedingly small." But "Under adverse [fol. 6943] combinations of the conditions considered, it was estimated that people could be killed at distances up to fifteen miles, and injured at distances of about forty-five miles. Land contamination could extend for greater distances." Undisputed testimony before the Commission shows that there is a "possibility of a major disaster, even though it has a low probability".

As the Commission said, "the question of safety obviously cannot be considered without regard to proposed location." The Commission found: "The site is bordered on one side by water and provides an exclusion area on the land side with a minimum radius of 2900 feet. The population distribution for given distances from the site is as follows: 1 mile, population 175; 2, 600; 5, 1,800; 10, 31,300; 20, 187,100; 30, 2,001,700. During the summer months the population within five miles would be increased due to vacationing transients and to the fact that beaches two to five miles southwest of the site may be crowded with thousands of people."

We think it clear from the Congressional concern for safety that Congress intended no reactor should, without compelling reasons, be located where it will expose so large a population to the possibility of a nuclear disaster. It does not appear that the Commission found compelling reasons or saw that such reasons were necessary. It said: "The evidence of record with respect to site gives reasonable assurance that the site is satisfactory from structural and underground water flow standpoints. The meteorology of the site is complex, but no reason appears in the record for it to be disqualifying. The site makes

possible extensive safeguards against the inadvertent release of liquid contaminants. . . . Studies of weather, hydrology, geology, and similar problems have yielded considerable information and are still in progress. Although the data of these types are not yet complete or conclusive, the record gives reasonable assurance that safe operation of the reactor will be as likely in that [fol. 6944] location as in any other location."[3] We think this finding clearly insufficient. We need not consider whether even the most compelling reasons for preferring this location could support a finding that the reactor could be operated at this location without "undue" risk, or with "adequate" protection, to the health and safety of the public.

Because we think the safety findings insufficient, we must set aside the Commission's grant of a construction permit and remand the case for such further proceedings consistent with this opinion as the Commission may determine. We need not consider other points raised by the petitioners.

BURGER, Circuit Judge, dissenting:

I dissent because I think there is no occasion at this time for the court to reach the issue of the ultimate safety of the plant's operations. The Commission has issued only a provisional permit to build a plant, not to operate it. The plant cannot go into operation until and unless the intervenor PRDC meets the safety provisions of the Act.

The sole basis of challenge to the provisional construction permit is that the *future possibility* that an operating permit will be unlawfully and improperly issued by the

[3] The Commission continued: "We anticipate that knowledge to be acquired will fortify that assurance. . . . It is possible that there may be presently unknown effects in large fast reactor systems. A prototype of the proposed reactor at a remote location has been urged as affording greater assurance against the possibility of such unknown effects than does the presently planned experimental and theoretical programs. (sic) The Commission finds that the necessity, however, for constructing such a prototype has not been shown. If the program of meltdown investigation should prove inconclusive, it will be necessary to reconsider the question of need for a prototype."

[fol. 6945] Commission creates a "present," "immediate" and "unavoidable threat" of injury. I do not think we have any occasion to consider what is not now before us. The Commission expressly deferred action on that issue. This does not appear to me a "final order" which gives us jurisdiction to pass on the ultimate issue of safety; nor does it empower us to tell the Commission that it must pass on the ultimate safety of the operation before the plant is constructed. Orders are not final as to a person "unless and until they impose an obligation, deny a right or fix some legal relationship as a consummation of the administrative process." *Chicago & Southern Air Lines, Inc.* v. *Waterman Steamship Corp.*, 333 U.S. 103, 113 (1948).

In an area involving as much scientific uncertainty as development of nuclear energy for peaceful purposes, the Commission must be permitted to proceed step by step, *i.e.*, make its preliminary finding of probable safety when the construction permit issues and reserve final approval of operations until a later date.

I respectfully suggest that my colleagues are undertaking to assume responsibilities which Congress vested in the Commission. This is illustrated in the majority's statement.

> "No reactor should, without compelling reasons, be located where it will expose so large a population to the possibility of a nuclear disaster."

On what evidence does the majority make a finding of "nuclear disaster" directly opposed to the finding which the Atomic Energy Commission made? The majority is, in effect, telling the Atomic Energy Commission that it has made an *unwise* decision on the location of the plant.

The majority also goes beyond the established limits of judicial review when it states:

> "The economy cannot afford to invest enormous sums in the construction of an atomic reactor that will not be operated. If enormous sums are invested without [fol. 6946] assurance that the reactor can be operated with reasonable safety, pressure to permit operation

without adequate assurance will be great and may be irresistible."

From an erroneous premise drawn out of thin air, the majority proceeds to draw an unwarranted conclusion. On what evidence can we as judges say our "economy cannot afford," or even that these appellees cannot afford, this large investment for peaceful uses of nuclear energy? I suggest our entire history is to the contrary. We invested not mere millions but *billions* in the original development of nuclear fission on a totally unproven theory of physics. It was an act of faith in the views of scientists. Surely it cannot be seriously suggested that these giants of American industry which formed PRDC are not well able—and willing—to risk the loss of millions in experiments and research. Forty or fifty million dollars to the sponsors of PRDC is a small investment to risk for the world's first known experiment of this kind into peaceful uses of nuclear energy.

If we were dealing with a radio or TV license or some other purely commercial enterprise in a developed and mature industry I would agree that there is a risk that large investment in machines might conceivably exert a subtle influence on the ultimate grant of an operations permit. Cf. *Community Broadcasting Co.* v. *Federal Communications Commission*, Nos. 15313, 15314 (D.C.Cir., Feb. 8, 1960). But I cannot join in the suggestion that members of the Atomic Energy Commission who have assumed obligations under oaths as binding as ours would permit an operation dangerous to the public because 40 or 50 million dollars is invested in brick, mortar and steel by men who knew from the outset they were engaged in a scientific gamble. And if any administrative agency should so abdicate its responsibilities in a matter as grave as this—which I cannot believe is likely—the courts are always in a position to exercise a final and stringent scrutiny on the issue of public safety.

[fol. 6947] Development in an area like this must, of necessity, proceed step by step. The Commission has found that the issuance of the construction permit on a provisional and restricted basis "does not in any manner adversely

affect the health and safety of the public or that of the [petitioners]." The appellants do not attack this finding.

At this stage how can anyone know what the result will be? This court considered a challenge not unlike that of appellants' challenge in *Associated-Banning Co. v. United States*, 247 F.2d 557, 561 (1957): "We cannot assume that the Board will not conduct its hearing within the intendment of the Act, so far as it may apply. It may well be, for all we are shown, that the Board's ultimate action will completely dispel every prospective fear voiced by the protest and the complaint. It is clear that the Board has not as yet entered an order 'final' as to these petitioners."

The essence of the majority action is found in its acceptance of the idea that once the Commission has permitted PRDC to invest its millions in the plant they are "bound" or "likely" to relax their notion of what is safe or dangerous in order to bail out the investors.

I emphasize that I cannot for a moment believe the sponsors of PRDC are so naive that they would think their investment of these millions is not speculative just as is most research. Nor can I believe they think that any amount of invested capital will persuade the Atomic Energy Commission to make a finding of safety which is not supported by substantial scientific evidence. It is entirely possible that PRDC might find itself the owner of a 50 million dollar scientific "white elephant" if, after completion of construction, it cannot satisfy the safety standards of the statute. Should that be the case it will be simply one of the unproductive steps in what promises to be a program to open to mankind sources of power undreamed of only a few years ago.

[fol. 6948] [File endorsement omitted]

IN UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT
No. 15,271—September Term, 1959

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL-CIO; UNITED AUTOMOBILE, AIRCRAFT AND AGRICULTURAL IMPLEMENT WORKERS OF AMERICA; and UNITED PAPERMAKERS AND PAPERWORKERS, Petitioners,

v.

UNITED STATES OF AMERICA and ATOMIC ENERGY COMMISSION, Respondents,

POWER REACTOR DEVELOPMENT COMPANY, STATE OF MICHIGAN, Intervenors.

On Petition to Review an Order of the Atomic Energy Commission.

Before: Edgerton, Bazelon, and Burger, Circuit Judges.

JUDGMENT—June 10, 1960

This case came on to be heard on the record from the Atomic Energy Commission, and was argued by counsel.

On Consideration Whereof, It is ordered and adjudged by this court that the order of the Atomic Energy Commission on review in this case is set aside, and that this case is remanded to the said Atomic Energy Commission for such further proceedings consistent with the opinion of this court as the Commission may determine.

Per Circuit Judge Edgerton.

Dated: June 10, 1960.

Separate dissenting opinion by Circuit Judge Burger.

[fol. 6949] [File endorsement omitted]

IN UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

[Title omitted]

Before: Prettyman, Chief Judge, Edgerton, Wilbur K. Miller, Bazelon, Fahy, Washington, Danaher, Bastian and Burger, Circuit Judges, in Chambers.

ORDER DENYING PETITION OF POWER REACTOR DEVELOPMENT COMPANY FOR A REHEARING IN BANC—July 25, 1960

Upon consideration of the petition of intervenor Power Reactor Development Company for a rehearing in banc, it is

Ordered by the court that the aforesaid petition is denied.

Per Curiam.

Dated: July 25, 1960.

Circuit Judges Miller and Bastian would grant the petition for rehearing in banc.

Circuit Judges Washington and Burger did not participate in this order.

[fol. 6950] [File endorsement omitted]

IN UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

[Title omitted]

Before: Prettyman, Chief Judge, Edgerton, Wilbur K. Miller, Bazelon, Fahy, Washington, Danaher, Bastian and Burger, Circuit Judges, in Chambers.

ORDER DENYING PETITION OF RESPONDENTS FOR A REHEARING IN BANC—July 25, 1960

Upon consideration of respondents' petition for a rehearing in banc, it is

Ordered by the court that the petition for rehearing in banc is denied.

Per Curiam.

Dated: July 25, 1960.

Circuit Judges Miller and Bastian would grant the petition for rehearing in banc.

Circuit Judges Washington and Burger did not participate in this order.

[fol. 6951] [File endorsement omitted]

IN UNITED STATES COURT OF APPEALS

FOR THE DISTRICT OF COLUMBIA CIRCUIT

[Title omitted]

Before: Fahy, Acting Chief Judge, in Chambers.

ORDER STAYING TRANSMISSION OF CERTIFIED COPIES OF OPINION AND JUDGMENT—August 8, 1960

Upon consideration of intervenor's motion for stay of transmission of certified copies of the opinion and judgment of this court, and it appearing that no objections have been filed, it is

Ordered that transmission of the certified copies of the opinion and judgment of this court is stayed to and including August 15, 1960.

Dated: August 8, 1960.

[fol. 6952] Clerk's Certificate to Foregoing Transcript (omitted in printing).

[fol. 6953]

SUPREME COURT OF THE UNITED STATES

No. 315—October Term, 1960

POWER REACTOR DEVELOPMENT COMPANY, Petitioner,

vs.

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL-CIO, et al.

ORDER ALLOWING CERTIORARI—November 14, 1960

The petition herein for a writ of certiorari to the United States Court of Appeals for the District of Columbia Circuit is granted, limited to Questions 1 and 2 presented by the petition for writ of certiorari. The case is consolidated with No. 454 and a total of two hours is allotted for oral argument.

And it is further ordered that the duly certified copy of the transcript of the proceedings below which accompanied the petition shall be treated as though filed in response to such writ.

[fol. 6954]

SUPREME COURT OF THE UNITED STATES

No. 454—October Term, 1960

UNITED STATES et al., Petitioners,

vs.

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL-CIO, et al.

ORDER ALLOWING CERTIORARI—November 14, 1960

The petition herein for a writ of certiorari to the United States Court of Appeals for the District of Columbia Circuit is granted, limited to Questions 1 and 2 presented by the petition for writ of certiorari. The case is consolidated with No. 315 and a total of two hours is allotted for oral argument.

And it is further ordered that the duly certified copy of the transcript of the proceedings below which accompanied the petition shall be treated as though filed in response to such writ.

LE COPY

No. 515

SUPREME COURT, U.S.
FILED

Supreme Court of the United States

OCTOBER TERM, 1960

POWER REACTOR DEVELOPMENT COMPANY, *Petitioner*,

v.

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL-CIO, *et al.*, *Respondents*

PETITION FOR A WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

JOHN LORD O'BRIAN,
W. GRAHAM CLAYTOR, JR.,
701 Union Trust Building,
Washington 5, D. C.

EDWARD S. REID, JR.,
RICHARD B. GUSHEE,
3456 Penobscot Building,
Detroit 26, Michigan,

Attorneys for Petitioner,
Power Reactor Development Company

[illegible] & BURLING,
Washington, D. C.

[illegible] CANFIELD, PADDOCK AND STONE,
Detroit, Michigan

Of Counsel

12, 1960

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Supreme Court of the United States

OCTOBER TERM, 1960

No. —

POWER REACTOR DEVELOPMENT COMPANY, *Petitioner*,

v.

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL-CIO, *et al.*, *Respondents*

PETITION FOR A WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

Petitioner Power Reactor Development Company (hereafter called PRDC) prays that a writ of certiorari issue to review the judgment of the United States Court of Appeals for the District of Columbia Circuit of June 10, 1960 (App. B, p. 42). A majority of a division of this court (Judges Edgerton and Bazelon, with Judge Burger dissenting) ordered to be set aside a unanimous decision and order of the Atomic Energy Commission which had continued in effect, subject to further proceedings, a provisional construction permit for a developmental power reactor being constructed by PRDC. The court held that findings made by the Commission in accordance with its regulations and settled practice were insufficient to satisfy the requirements of the Atomic Energy Act of 1954. The effect of the decision is to invalidate a key provision of the Commission's regulations which established a step-by-step licensing procedure essential to meet the technological requirements of developmental atomic reactors, to upset the uniform practice followed by the Commission thereunder

in reactor construction permit cases, and to throw grave doubt on the Commission's authority to approve construction of such reactors at all within reasonable distances of populated centers.

OPINIONS BELOW

The final opinion and decision of the Atomic Energy Commission is not reported. It is contained in the Joint Appendix printed for the Court of Appeals at Tr. 6933 *et seq.*[1] The opinion of the Court of Appeals (App. B, p. 42) has not yet been reported.

JURISDICTION

The judgment of the United States Court of Appeals for the District of Columbia Circuit was entered June 10, 1960 (App. B, p. 42). Timely petitions for rehearing *en banc* by both the Government and petitioner were denied on July 25, 1960, Judges Miller and Bastian dissenting and Judges Washington and Burger not participating. The jurisdiction of this Court is invoked under 28 U.S.C. § 1254 (1).

QUESTIONS PRESENTED

1. In accordance with its uniform practice, the Atomic Energy Commission issued to petitioner PRDC a "provisional" construction permit authorizing construction, but not start-up or operation, of a developmental nuclear reactor. The Commission's order was supported by findings provided for in Section 50.35 of its regulations that there was reasonable assurance that a facility "of the general type proposed" could be constructed and operated at its location without undue risk to the health and safety of the public. On petition for review, the Court of Appeals for the District of Columbia Circuit held such findings insuffi-

[1] References herein to pages of the transcript of record ("Tr. ——") are to the folio pagination of the original record in this proceeding certified by the Secretary of the Commission and lodged with the Clerk of this Court. This pagination is preserved in the excerpts from this record included in the Joint Appendix printed for the Court of Appeals, nine copies of which have been filed with the Clerk in accordance with Rule 21(4).

cient to satisfy the requirements of the Atomic Energy Act of 1954. The first question presented is whether, as the court held, the Commission lacks authority under the Act to issue reactor construction permits on the basis of the findings called for by its regulation, and whether such regulation and the Commission's settled practice thereunder are accordingly invalid.

2. The Commission here made the findings contemplated by its regulations that the location of the proposed reactor was suitable, and these findings were not attacked as unsupported by the evidence. As an alternative ground of decision, however, the court below held such findings inadequate because it construed the Atomic Energy Act generally as requiring a further finding of "compelling reasons" for approval of a site for any power reactor located within a moderate distance (30 miles) of a substantial population. In this respect the reactor location is generally comparable to that of most other power reactors heretofore authorized by the Commission. The second question presented is whether, as the court held, the Commission is without power under the Act to authorize construction of nuclear reactors within such moderate distances of populated centers without finding "compelling reasons" therefor, and whether, indeed, as the decision below implies, no reasons can be sufficiently compelling, regardless of the technical safeguards provided, to justify location of such licensed reactors in any but remote areas.

3. The only interest asserted by respondent labor unions here is that of their members located in the general area of the proposed reactor in not having their safety or property subjected to unreasonable hazard from its operation, after completion of construction. The Commission's order specifically authorizes only construction, and provides that no license to operate the reactor will be granted unless, in further proceedings to which respondents will be parties, petitioner PRDC can show that such operation will present no undue risk to them or the public. The third question presented is whether, under these circumstances, respondents have been "aggrieved" by an order of the Commis-

sion which is "final" as to them, and whether the court below therefore had jurisdiction to entertain their petition for review. Atomic Energy Act of 1954, as amended, Section 189 b; Judicial Review Act of 1950, as amended, Sections 2, 4; Administrative Procedure Act, Section 10 (App. C, pp. 62-66).

STATUTES AND REGULATIONS INVOLVED

The pertinent provisions of the Atomic Energy Act of 1954, 68 Stat. 919, as amended, 42 U.S.C. §§ 2011 *et seq.*; of the Judicial Review Act of December 29, 1950, 64 Stat. 1129, as amended, 5 U.S.C. §§ 1031 *et seq.*; of the Administrative Procedure Act, 60 Stat. 237, 5 U.S.C. §§ 1001 *et seq.*; and of Sections 50.34 and 50.35 of the Atomic Energy Commission's regulations (10 CFR §§ 50.34, 50.35), are set forth in Appendix C (pp. 56-68).

STATEMENT

Petitioner PRDC is a non-profit membership corporation, each of whose 21 members is a substantial public utility or industrial corporation in the United States (Finding 1, Tr. 7013; Tr. 6990-91). It is engaged in the construction of a developmental fast-neutron breeder reactor[2] at Lagoona Beach, Monroe County, Michigan, an essentially rural area on the shore of Lake Erie, approximately 30 miles southwest of Detroit. It is undisputed that this is not a commercial venture in any sense, but is "a research and development facility" (Finding 2, Tr. 7013). In accordance with this concept the member companies of PRDC have no capital investment as such in the project. Their substantial financial contributions are treated as having

[2] A summary description of the reactor and the principal features which make it an important step forward in nuclear development is contained in the Commission's opinion at Tr. 6972-75. A more extensive but simple and lucid explanation of the basic principles of power reactors, and particularly of "fast breeder" reactors, is contained in the testimony of Dr. Hans A. Bethe, a PRDC consultant and one of the world's leading nuclear physicists (printed Joint Appendix, Vol. III, Tr. 3955-60).

been expended for research and development and not as having been invested or capitalized in the ordinary sense. PRDC's articles of incorporation specifically provide that no part of any net earnings may inure to the benefit of its members. They also provide that contributions made may not be repaid to them in whole or in part, even on dissolution, since in that case any remaining net assets must be devoted to educational or scientific purposes (Tr. 3923, 5137-43).

On January 6, 1956, PRDC filed its application for license under Section 104 b of the Atomic Energy Act of 1954 for the construction and operation of its proposed nuclear reactor as a research and development project (Tr. 5716). On August 4, 1956, the Commission issued to PRDC a construction permit "on a provisional basis" under Section 50.35 of its regulations (Tr. 6290-95). Shortly thereafter, respondent labor unions intervened in the proceeding. They opposed continuation of the permit on the sole claim that PRDC had failed to make a sufficient showing that *operation* of the proposed reactor, following its completion, would not create a hazard to them, their members, and their property in the general vicinity of Detroit (Tr. 6298). It was agreed from the outset that actual construction of the reactor—the only activity authorized by the construction permit—presented no hazard to the respondents or the public.

Following an extensive hearing before a hearing examiner, and briefs and oral argument before the Commission itself, the Commission entered an initial decision modifying and continuing the provisional construction permit in effect (Tr. 6873 *et seq.*). After further consideration of exceptions filed by respondents and briefs by all parties, the Commission unanimously (Commissioners Vance, Floberg and Graham) entered its final order of May 26, 1959, affirming its initial decision (Tr. 6933-7033).

1. The Decision of the Commission

Section 50.34 of the Commission's regulations specifies the technical information required to be included in appli-

cations for reactor licenses generally (App. C, pp. 66-67). Section 50.35, entitled "Extended time for providing technical information", authorizes the issuance of construction permits "on a provisional basis," prior to submission of all technical data required by Section 50.34, on a finding by the Commission, *inter alia*, of "reasonable assurance that a facility *of the general type proposed* can be constructed and operated at the proposed location without undue risk to the health and safety of the public" (italics supplied; see full text of regulation in App. C, pp. 67-68, below). Issuance of an operating license is specifically subject to the later production by the applicant of the requisite additional technical information when it becomes available, and to the subsequent definitive determination by the Commission after hearing, before such license can be issued, that "the final design provides reasonable assurance that the health and safety of the public will not be endangered." The provisional construction permit contemplated by this provision of the regulations thus authorizes only construction, and carries no presumption or implication that an operating license will follow, unless the applicant is later able to sustain the burden of adequately showing the safety of "the final design" of the reactor.

The Commission in its opinion and decision here made the precise findings called for by its regulations. It found in the words of Section 50.35 that there was "reasonable assurance", for purposes of the provisional construction permit in question, that "a utilization facility *of the general type proposed* in the PRDC Application and amendments thereto can be constructed and operated at the location without undue risk to the health and safety of the public" (italics supplied) (Finding 22, Tr. 7020; see also Finding 30, Tr. 7022; Finding 32, Tr. 7023; Tr. 6983-84). As explained more fully below (p. 15), the construction permits issued for every one of the eight other developmental power reactors authorized to date have been similarly "provisional" permits, issued under this regulation, and have been supported by the same finding of reason-

able assurance of safety in terms of "the general type proposed".

None of the safety findings made by the Commission was attacked by respondents in their petition for review as unsupported by the evidence and, accordingly, they must be accepted as established here.

In its opinion and decision the Commission made it perfectly clear that it interpreted Section 50.35 of its regulations as requiring a less definitive determination of safety of operation for issuance of a "provisional" construction permit than would be subsequently required to support issuance of an operating license:

> "The degree of 'reasonable assurance' with respect to safety that satisfies us in this case for purposes of the *provisional* construction permit would not be the same as we would require in considering the issuance of the *operating* license" (AEC Opinion, Tr. 6987).

In fact, the establishment of this step-by-step licensing procedure was the very objective of the regulation, an objective made necessary by the nature and inherent characteristics of a developmental reactor in the setting of the present status of nuclear progress. See AEC Opinion, Tr. 6983, and pp. 17-19, below. Accordingly, the Commission stated that, as Section 50.35 of its regulations contemplates, its determinations with respect to safety of operation were made for purposes only of the provisional construction permit. It emphasized that no decision was being made or implied on the safety issue that would be presented in connection with the further proceedings which must be had before an operating license could issue, and which would be judged by the more severe standards of reasonable assurance then called for (Tr. 6956-57, 6987). An extensive and detailed procedure for continuing review of this and other questions was specifically provided for in the decision (Tr. 7023-24), in the order entered (Tr. 7025-26, 6887-88), and in the terms of the amended construction permit itself (Tr. 7029-31).

As the Commission stated it,

> "Before we authorize the issuance of an operating license to PRDC at a further reopening of this proceeding, we will require that all safety questions be answered to our complete satisfaction, as required by the statute and our regulations. Under such circumstances, the public interest and that of the Intervenors [respondents] have been protected" (Tr. 6938). See also amended construction permit, Tr. 7030-31.

From the outset, PRDC has understood and accepted the fact that issuance of its provisional construction permit carries with it no implication whatever that an operating license will later be granted. It has explicitly recognized that if it should be unable to sustain the burden of showing that the reactor as completed can be safely operated in accordance with the strict standards of proof required by the Commission for such determination, it would not be able to obtain authority to operate the reactor. The assumption of this financial risk was willingly accepted in this non-profit research undertaking as an inevitable concomitant of progress in nuclear technology at this early stage of development of the art. The Commission in its opinion stated:

> "It would be hard to imagine a case where an applicant would be less able to argue that he had been misled by previous favorable Commission action. Under the circumstances of this case, moreover, and in view of the wording of the provisional construction permit, it is perfectly clear that PRDC is assuming a substantial financial risk with its eyes wide open, and that the generation of any pressure from such ingredients would be quite absurd".[3]

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[3] Tr. 6956-57. It should be emphasized again that this is not a commercial enterprise whose sponsors could unexpectedly find themselves in the position of having wasted a large capital investment in an unusable "white elephant". The nature of this project as a research and development undertaking is inherently such that, even in the unlikely event that for some reason opera-

2. The Decision of the Court of Appeals

Respondent labor unions duly filed with the Court of Appeals for the District of Columbia Circuit a petition to review the Commission's decision under Section 189 b of the Atomic Energy Act and the provisions of the Judicial Review Act of December 29, 1950, as amended, and of the Administrative Procedure Act (App. C, pp. 62-66). On June 10, 1960, a majority of a division of that court reversed the Commission and ordered the provisional construction permit set aside. The opinion of the court was written by Judge Edgerton and concurred in by Judge Bazelon, with Judge Burger dissenting.

The court recognized that respondents had not shown any injury from construction of the reactor—the only activity authorized by the Commission's order. It also recognized that this order specifically provided for further proceedings including a *de novo* hearing, prior to operation, on the only question in which respondents had a legitimate interest—whether the reactor as actually completed could then be operated without undue risk to them and to the public (App. B, pp. 44-45). Nevertheless, the court held that the Commission's order was "final" with respect to these respondents and sufficiently "aggrieved" them to make it reviewable under applicable statutes (*id.* at p. 45).

On the merits, the court held that the relevant provisions of the Atomic Energy Act of 1954 required the Commission to make essentially the same finding with respect to safety of operation of a proposed reactor "as of the time the construction permit is issued" that it admittedly must make "when it authorizes operation" (App. B, p. 45). The court nowhere cited or discussed Section

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tion of the plant must be seriously postponed or cannot be undertaken at all, the substantial practical engineering information and experience developed in its design, construction and nonnuclear testing would make it a success from the research and development standpoint, and the data thus obtained would be of great value to later generations of reactors. This position of PRDC has been repeatedly stated on the record, and was accepted by the Commission. See AEC Opinion, Tr. 6956, n. 31.

50.35 of the Commission's regulations. As stated above, this regulation establishes a two-stage procedure calling for the issuance of "provisional" construction permits on the basis of an initial finding of reasonable assurance of safety only "of the general type proposed", to be followed by a more definitive finding, prior to issuance of an operating license, that "the final design provides reasonable assurance that the health and safety of the public will not be endangered." Ignoring this regulation, the court held that the Commission must make initially the ultimate finding that "the reactor" can be operated at the proposed site without undue risk (App. B, p. 45). The effect of the court's decision is necessarily to invalidate Section 50.35 of the Commission's regulations and the step-by-step licensing concept which it embodies.

The court went on to discuss certain of the Commission's findings with respect to the proposed reactor and reactors of the "general type proposed", failed to recognize the distinction drawn by the regulation between these two types of findings, and held such findings accordingly not to have satisfied the statute as interpreted (App. B, pp. 48-51). While admitting that there were strong practical and technical reasons behind the Commission's step-by-step licensing policy (App. B, p. 50), the court relied upon an isolated item selected from the extensive legislative history of the Act to support the conclusion that Congress intended to deprive the Commission of authority to follow such procedure (*id.* at pp. 46-48). It recognized that its interpretation of the statute might be doubtful, but it resolved that doubt against the Commission, contrary to ordinary canons of statutory construction (*id.* at p. 48).

The court rested its decision on the merits on an additional ground which also has most serious implications for effective administration of the Act and for the future of the country's nuclear development program. After quoting from statements in the introduction to a technical Commission study with respect to the "possible consequences" of "certain hypothetical major accidents" which might occur in "a typical large nuclear power reactor", the

court concluded, without referring to any identified statutory provision or to any specific item of legislative history, "that Congress intended no reactor should, without compelling reasons, be located where it will expose so large a population to the possibility of nuclear disaster" (App. B, p. 52). By adding the dictum that it need not now consider "whether even the most compelling reasons for preferring this location" could support a finding that the reactor could be operated there without undue risk (*ibid.*), the court indicated that its basic intent was, as a practical matter, to deter the Commission from approving the location of *any* reactor in an area having a population density comparable to that found here.[4] The Commission, of course, did not here and has not in any other reactor licensing case considered it either necessary or appropriate to find "compelling reasons" for the selection of a particular location so long as it made the findings required by its regulations.

Judge Burger vigorously dissented from all aspects of the court's decision. As he put it, the sole basis on which the respondents were challenging the Commission's order was that there was a "future possibility" that an operating permit would subsequently be "unlawfully and improperly issued by the Commission". In his view, accordingly, the order of the Commission was not a "final order" of the sort which properly "aggrieved" the respondents or gave the court jurisdiction on a petition for review (App. B, p. 53, below). On the merits, he considered the Commission's practice in issuing provisional construction permits fully consistent with the statute, stating that

> "In an area involving as much scientific uncertainty as development of nuclear energy for peaceful purposes, the Commission must be permitted to proceed step by step, *i.e.*, make its preliminary finding of probable safety when the construction permit issues and

[4] As noted below (pp. 27-28), the population distribution characteristics of this site are generally comparable to those of other reactors thus far authorized by the Commission.

reserve final approval of operations until a later date" (App. B, p. 53, below).

Finally, Judge Burger characterized that aspect of the decision dealing with the suitability of the location of the reactor as an unwarranted assumption by the court of "responsibilities which Congress vested in the Commission" (*ibid.*). He accordingly thought that the petition for review should have been dismissed.

Petitions for rehearing *en banc* filed by both the Government and PRDC were denied by the court by order entered July 25, 1960, Judges Miller and Bastian dissenting, and Judges Washington and Burger not participating in such order.

REASONS FOR GRANTING THE WRIT

This is the first case in which the courts have been asked to construe the regulatory provisions of the Atomic Energy Act of 1954. In a new and vitally important area in which expert knowledge and experience are probably more relevant than in any other, a majority of the court below has held the Commission's consistent practice in issuing construction permits for developmental power reactors "on a provisional basis" to be contrary to the statute, and has *sub silentio* invalidated the Commission's regulation providing for this procedure (Question 1, pp. 13-25, below). The court has also imposed on the Commission its judgment with respect to reactor location policy in such a way as to cast grave doubt on the validity of both construction permits and operating licenses which the Commission has issued to numerous other reactors located in areas of comparable or greater population density, and of the Commission's settled practice in approving such locations (Question 2, pp. 25-32, below). In each of these two respects the decision below (1) presents an important question of federal law which has not been but should be settled by this Court, (2) frustrates in basic particulars the administration of the regulatory provisions of the Atomic Energy Act of 1954, and (3) contrary to the explicit policy of the statute, imposes a serious roadblock to progress in the

application of nuclear energy to peacetime purposes. It is therefore appropriate for review on certiorari by this Court. Compare *United Gas Pipe Line Co.* v. *Memphis Light, Gas and Water Division*, 358 U.S. 103, 109.

In holding the Commission's decision to be now reviewable at the instance of these respondents, the court below has also decided an important question with respect to reviewability of federal administrative agency decisions under the Judicial Review Act of 1950 and the Administrative Procedure Act (App. C, pp. 63-66), in a way inconsistent with fundamental principles laid down by this Court and accepted in other circuits (Question 3, pp. 32-38, below).

I

IN HOLDING THE COMMISSION'S SAFETY FINDINGS INSUFFICIENT TO SUPPORT ISSUANCE OF A PROVISIONAL CONSTRUCTION PERMIT THE COURT BELOW HAS OVERTURNED A COMMISSION REGULATION AND THE CONSISTENT ADMINISTRATIVE PRACTICE THEREUNDER AND HAS DECIDED AN IMPORTANT QUESTION OF FEDERAL LAW WHICH HAS NOT BEEN BUT SHOULD BE SETTLED BY THIS COURT.

A majority of the court below has held unequivocally that under the statute the Commission cannot issue a construction permit for a power reactor unless *at that time* it makes the same definitive findings with respect to safety of the proposed reactor that admittedly must be made prior to issuance of an operating license. The court quoted the contention of the respondents that

> "The Act and the regulations of the Commission . . . require, as conditions precedent to the issuance of every construction permit for an atomic energy power reactor, that *as of the time the construction permit is issued* the Commission find that (1) it has reasonable assurance that the reactor may be constructed *and operated* at the proposed site without undue risk to the health and safety of the public. . . ."

The court then added:

> "It is undisputed that the Commission must make such a finding when it authorizes operation. The question is whether it must make such a finding when it authorizes construction. In our opinion it must" (App. B, p. 45).

It is thus plain that, although the court neither discussed nor cited Section 50.35 of the Commission's regulations, the inevitable effect of its decision is to invalidate this regulation, the step-by-step licensing procedure which it provides, and the Commission's uniform practice of issuing construction permits for developmental power reactors thereunder "on a provisional basis". The regulation distinguishes between the degree of assurance of safety of "the general type proposed", required for a provisional construction permit, and the degree of assurance of safety of "the final design", required for an operating license (App. C, pp. 67-68). As the Commission made plain in its opinion (Tr. 6987), the basic concept of this provision is that a lesser degree of assurance of operating safety is sufficient for authorization of a provisional construction permit than is necessary for an operating license.[5] It was only because the court below rejected this concept and confused the distinction between the two types of findings contemplated by Section 50.35 that it held the findings which the Commission actually made to be inadequate and ambiguous.[6]

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[5] As this Court has said, an administrative agency's interpretation of its own regulation is "of controlling weight unless it is plainly erroneous or inconsistent with the regulation". *Bowles* v. *Seminole Rock Co.*, 325 U.S. 410, 414.

[6] In the passage from the court's opinion quoted above in the text (pp. 13-14), the distinction between findings with respect to "the reactor" and a reactor of "the general type proposed" was ignored. In spite of the provisions of Section 50.35 of the regulations, the court explicitly stated that, when the Commission authorizes construction, it must make a finding of reasonable assurance that "the reactor" can be constructed and operated at the proposed location without undue risk.

In fact, when the findings are read in the light of the Commission's explanation of its regulatory scheme, they are neither inadequate nor ambiguous.

The question presented by this aspect of the court's decision is of obvious importance to the proper administration of the Atomic Energy Act. Every one of the nine power reactors thus far licensed by the Commission—all "developmental" reactors under Section 104 b of the Act—has been issued a provisional construction permit based on similar findings of reasonable assurance of safety "of the general type proposed." See App. A, Part I, pp. 40-41, below. The great majority of permits for smaller training and research reactors have similarly been "provisional" and issued on the basis of the same finding.[7]

Apart from this consistent practice, however, a summary consideration of the relevant statutory provisions and their setting will make clear that the Commission's regulation and action thereunder are not only in full accord with the Atomic Energy Act, but are essential to the attainment of its primary objectives. The decision of the court below is based in large part upon a misunderstanding or disregard of the Commission's expert evaluation of complex technical factors inherent in the construction of developmental power reactors at this early stage of the application of atomic energy for peaceful uses.

First. The Atomic Energy Act of 1954 is one of the landmark statutes of the post World War II period. Its specific provisions as well as its extensive legislative history[8] make abundantly plain that the impulse behind it was wide-

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[7] The Commission now requires these same findings also to be made in connection with AEC-owned power reactors being built under its Power Demonstration Reactor Program, which reactors are not required to be licensed under the Act. See, *e.g.*, City of Piqua, Ohio, 24 Fed. Reg. 8279-80, and App. A, Part II, p. 41, below.

[8] This legislative history (of 3994 pages) has been organized and published in three volumes. See *Legislative History of the Atomic Energy Act of 1954* (U.S. Atomic Energy Comm., Govt. Print. Off., 1955). It is hereafter cited as *Legis. Hist.*

spread. Congressional recognition of the urgent need to accelerate the development of atomic energy for peaceful purposes by increasing to the maximum extent the opportunities for participation by private industry. Members of the Joint Committee on Atomic Energy acknowledged repeatedly that the United States was engaged in a crucial race for supremacy in peacetime atomic progress and that exploitation of the ingenuity and inventiveness of private enterprise was essential. Congress acted on an impressive body of evidence that demonstrated the desirability of private industrial development of many different kinds of nuclear reactors, and that emphasized the importance of speed in such development in order to maintain American leadership in this field.[9]

In the specific provisions of the Act, Congress drew a sharp line between commercial projects to be licensed under Section 103 and research and development projects to be licensed under Section 104 (App. C, pp. 57-59). Particular emphasis was laid upon the importance of "utilization and production facilities [reactors] involved in the conduct of research and development activities leading to the demonstration of the practical value of such facilities for industrial or commercial purposes", to be licensed under Section 104 b—the class of project involved here. This Section 104 b of the Act further provides that in issuing licenses thereunder "the Commission shall impose the minimum amount of such regulations and terms of license as will permit the Commission to fulfill its obligations under this Act to promote the common defense and security and to protect the health and safety of the public". It admonishes

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[9] See, *e.g.*, II *Legis. Hist.* 1831-32; III *id.* 2879, 3004, 3723; statement of Dr. Lawrence R. Hafstad, Director of Reactor Division, *Hearings Before the Joint Committee on Atomic Energy on Atomic Power Development and Private Enterprise*, 83rd Cong., 1st Sess. (1953), pp. 22-23.

See also Atomic Energy Act of 1954, Sections 1, 3 a, d, and 104 b, App. C, pp. 56, 58, below.

that "priority shall be given to those activities which will, in the opinion of the Commission, lead to major advances in the application of atomic energy for industrial or commercial purposes" (App. C, p. 58). The Commission here found that the proposed PRDC reactor is such an activity (Findings 10, 26, Tr. 7016, 7021-22).

Section 182 a of the Act (App. C, pp. 60-61) spells out the nature of the Commission's obligations recited in Section 104 b with respect to protection of the "health and safety of the public" by providing specifically that in connection with applications for "*licenses to operate* production or utilization facilities" the applicant shall state such technical specifications and other information as the Commission's regulations shall require to enable it to find that there will be "adequate protection to the health and safety of the public" (italics supplied). This subsection imposes no statutory requirements with respect to the issuance of constructon permits as such. Section 185, which does deal in terms with construction permits, contains no provision covering the findings required at that stage, but its language indicates a recognition by Congress that an initial application for such a permit need not and in many instances cannot contain all the technical information required to be evaluated at the time the subsequent operating license is considered (App. C, p. 62).

Second. With these new statutory provisions before it, and with its expert knowledge of the technical problems involved in the task of developing safe and economically feasible nuclear electric power, the Commission was faced at the outset of its administration of this Act with the very practical problem of determining what showing was to be required at the construction permit stage. Of most pressing importance were the procedures to be utilized in licensing developmental and research reactors under Section 104 b—the projects which Congress had ordered be given priority, and in fact the only class of power reactors

for which licenses have thus far been sought or issued. The Commission was plainly aware, and specifically found here, that

> "It is in the nature of reactor design, although certainly not unique to it, that many features remain to be designed and demonstrated after construction is begun—and indeed some features redesigned and replaced after operation is under way. . . ." (Tr. 6983.)

The Commission also quoted approvingly (*ibid.*) the uncontradicted testimony of the late Dr. Mark Mills, a member of the Advisory Committee on Reactor Safeguards, that "[p]ractically all advanced technological developments take place with a sort of combined construction and research and development and necessary dovetailing of these things . . .". (Tr. 3278), and of Dr. Hans Bethe that "the simultaneous pursuit of programs of research, development and construction has become standard in the fast-moving field of atomic energy and is necessary in order to keep abreast or ahead of our competitors" (Tr. 3960).[10]

The Commission has thus understood fully from the outset that a developmental reactor as contemplated by Section 104 b is by its nature a step beyond previously proven devices. Continuing design modification based on experience obtained from actual construction and in-place testing is unavoidable for this type of project. It was readily apparent to the Commission, therefore, that to require a definitive safety finding with respect to operation of such a reactor at the construction permit stage could

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[10] With respect to this particular reactor, the Commission further stated that

> "As in the case of any other power reactor at this stage of the art, in addition to the design features of the reactor which will be determined and demonstrated before the actual construction of the reactor, many other such features will be determined and demonstrated during its actual construction. This fact merely underlines the importance of the development of the first breeder reactor at an early date" (Tr. 6975).

render it near-impossible ever to allow non-Governmental bodies to construct reactors which would, in the words of the statute, "lead to major advances in the application of atomic energy for industrial or commercial purposes". At best it would considerably delay private development of atomic energy. Either result would be contrary to the clear Congressional policy to foster private developmental programs with the greatest practicable expedition.[11]

On the other hand, the Commission recognized that if no real showing with respect to probable safety of operation were initially required, ill-considered projects, having no substantial chance of successful completion or eventual licensing, might be encouraged, with resultant economic waste. Acting pursuant to the authority granted by Congress, the Commission accordingly promulgated Section 50.35 of its regulations as a sensible and practicable solution to this problem. The step-by-step procedure which it contemplates was designed to accommodate the technological facts of life, with which the Commission was fully acquainted, to the Congressional mandate.

Third. Neither the applicable statutory provisions nor anything in their legislative history requires or justifies the court's invalidation of this carefully devised regulatory scheme. As noted above, the plain provisions of Section 182 a require that the definitive determination of safety

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[11] At a later stage of development of the art, it may well be practicable to require a more definitive safety showing prior to the start of construction. Such a requirement, for example, might be imposed for reactors sought to be licensed under Section 103 of the Act as purely commercial ventures. With respect to some of the small research and training reactors already licensed, which the Commission in its opinion said "have become virtually production line items" (Tr. 6955), it has already been possible to issue construction permits on the basis of findings of "reasonable assurance that *the reactor* can be constructed and operated at the proposed location without undue risk to the health and safety of the public". See, *e.g.*, CPRR-50, *American Radiator and Standard Sanitary Corp.*, 25 Fed. Reg. 1968. Such a stage of development, however, is plainly not yet here for power reactors.

of operation of proposed reactors must be made in connection with applications for "licenses to operate" them (App. C, pp. 60-61). This provision is to be distinguished from the requirements of the other subsections of Section 182, all of which are applicable in general terms to any "license"—a generic term which, as provided in Section 185, includes construction permits as well as operating licenses unless the context otherwise indicates.

The court below relied heavily on an isolated passage from the extensive legislative history of this complex statute (App. B, pp. 46-48). This consists of a brief exchange on the floor of the Senate between Senators Humphrey and Hickenlooper (III *Legis. Hist.* 3759-60). Senator Humphrey (who opposed the administration bill throughout and voted against its passage by the Senate, *id.* at 3877) had offered an amendment to the construction permit provisions of the Act (Section 185) which would have required the "completion of the procedures established by Section 182 prior to the issuance of any construction permit" (*id.* at 3759). This amendment was one of several which had been urged in both Houses by opponents of the administration bill. Its basic purpose was to make specifically applicable to construction permits not the safety determinations which were (and are) explicitly required by Section 182 a only for an "operating license", but rather the notice and preference provisions of subsections 182 c and d (designated in the bill and in the Act as originally passed as subsections 182 b and c), and the hearing and judicial review requirements needed to implement these provisions.[12] This becomes plain when the history and setting of the amendment are considered.

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[12] Subsection c (originally b, App. C, p. 61) forbids issuance of any commercial license under Section 103 until notice has been given to appropriate state regulatory bodies and to municipal, cooperative or private utilities within transmission distance. Subsection d (originally c, App. C, p. 61) requires that "preferred consideration" for such Section 103 licenses be given to facilities located in high-cost power areas, and to public or cooperative bodies.

Senator Humphrey's amendment had been first advocated in the House by Representatives Holifield and Price (who also opposed and voted against the bill, III *Legis. Hist.* 2962-63) in their separate views attached to the Joint Committee's report on the bill. In this, they explained its basic purpose as to make construction permits "specifically subject to the same procedural safeguards, assuring interested parties full opportunity for notice, hearing, and appeal before issuance, as are provided in connection with the issuance of licenses under Section 182". (I *Legis. Hist.* 871; III *Legis. Hist.* 2857). On the preceding page of this same report they had urged that the notice and preference provisions of subsections 182 b and c, as they were then designated (footnote 12, above), should also be broadened to include public and cooperative bodies (I *Legis. Hist.* 870). Amendments to accomplish these latter objectives had been successfully sponsored in the Senate by Senator Humphrey prior to his introduction of the amendment now under discussion (III *Legis. Hist.* 3475, 3479).

At no time was the suggestion made that the proposed amendment concerned public safety; in the very minority report of the Joint Committee on Atomic Energy in which it had been first suggested, it was stated that the licensing provisions of the bill as originally reported lacked proper safeguards "except for the requirements of national security and public health and safety" (I *Legis. Hist.* 869). As a broader view of the legislative history shows, what Senator Humphrey and his colleagues were primarily worried about was that atomic energy might be used to foster large private monopolies to the detriment of the public and publicly owned facilities. They feared particularly that the effectiveness of the notice and preference provisions of Section 182, which had been successfully broadened by their amendments, might be limited if these provisions, and the hearing and judicial review procedure necessary to enable their enforcement by parties having the requisite interest, were not clearly applicable to construction permits as well as to operating licenses. It was in this context that Senator Humphrey

mentioned the possibility of pressure resulting from issuance of a construction permit.

Senator Humphrey's amendment was withdrawn when Senator Hickenlooper explained that the existing provisions of the bill, including changes which had been made in Section 189 making construction permits expressly subject to the hearing and judicial review provisions of the Act, rendered it unnecessary. In the light of this background, Senator Hickenlooper readily agreed that "a license and construction permit are equivalent" (III *Legis. Hist.* 3759). He obviously meant that they were equivalent from the standpoint of the procedural safeguards and the notice and preference provisions which had been in controversy.

That this was all that was intended, and that even the minority was not advocating the far-reaching limitation on the authority of the Commission to issue provisional construction permits which has now been imposed by the court below, is further indicated by Senator Humphrey's subsequent reference to this colloquy in a statement included in the Congressional Record just prior to the vote on the bill in the Senate. In this statement he described the interpretation discussed on the floor and principally relied on by the court below as "applying same preference standards to construction permits as provided by previous amendment for licenses to use atomic energy" (III *Legis. Hist.* 3877).

Considered in its full context, therefore, this fragment of the extensive debate on this Act is not entitled to the controlling weight given it below. Materials drawn from legislative history are most useful in revealing general purpose and not "the specific meaning of a statute on a particular occasion." Cox, *Judge Learned Hand and the Interpretation of Statutes*, 60 Harv. L. Rev. 370, 379 (1947). The exchange relied on is a good illustration of the wisdom of the proposition that "[a] loose statement even by a chairman of a committee, made impromptu in the heat of debate, less informing in cold type than when heard on the floor, will hardly be accorded the weight of

an encyclical." Frankfurter, *Some Reflections on the Reading of Statutes*, 47 Colum. L. Rev. 527, 543 (1947). The Commission rather than the court below has properly understood and applied the basic Congressional purpose as indicated both by the statutory provisions and by the Act's over-all legislative history.

Fourth. In upsetting the Commission's regulation and consistent practice, the court below has overstepped the bounds of judicial review and has disregarded limitations which this Court has frequently admonished the federal courts to follow. The regulation involved here was promulgated pursuant to authority expressly delegated to the Commission in Sections 161 and 182 a (App. C, pp. 59-61). The licensing provisions of the Act could not themselves come into effect until the framework they provided was built upon by these essential regulations. Congress plainly intended to grant the Commission substantial discretion of a quasi-legislative nature in implementing and effectuating the Act's basic purposes. See 1 Davis, *Administrative Law Treatise* (1958) § 5.03 pp. 302-03; compare *Addison* v. *Holly Hill Fruit Products, Inc.*, 322 U.S. 607, 613-14; *American Trucking Associations, Inc.* v. *United States*, 344 U.S. 298, 314.

It is axiomatic, also, that an agency's interpretation of the statute which it administers is entitled to great weight. As this Court aptly stated in *United States* v. *American Trucking Associations, Inc.*, 310 U.S. 534, 549, quoting with approval *Norwegian Nitrogen Co.* v. *United States*, 288 U.S. 294, 315:

> "This is peculiarly true here where the interpretations involve 'contemporaneous construction of a statute by the men charged with the responsibility of setting its machinery in motion, of making the parts work efficiently and smoothly while they are yet untried and new.'"

Where, in addition, the administrative agency is operating in a field involving a wholly new and extremely complex technology, the very understanding of which requires tech-

nical competence and skill of a high order, the courts should be particularly reluctant to overturn the agency's basic regulatory scheme. Compare *Board of Trade of Kansas City* v. *United States*, 314 U.S. 534, 548; *United States* v. *Storer Broadcasting Co.*, 351 U.S. 192, 203. And where, as here, the uniform and settled practice of the agency over a period of years since enactment of the statute has been in accordance with its regulation, and where this practice has repeatedly been brought to the attention of Congress but not dealt with in subsequent amendments,[13] there is even more reason for upholding the agency's interpretation. Compare *United States v. Shreveport Grain & Elevator Co.*, 287 U.S. 77, 84; *United States* v. *Bergh*, 352 U.S. 40, 46-47; *Ivanhoe Irrigation Dist.* v. *McCracken*, 357 U.S. 275, 292-94.

The justification given by the court below for refusing to apply these basic principles of judicial review is found in the statement that "[t]he possibilities of harm are so enormous that any doubt as to what findings the Act requires . . . should be resolved on the side of safety" (App. B, p. 48). This, of course, overlooks the Commission's uncontested determination that the issuance of this provisional construction permit "does not in any manner adversely affect the health and safety of the public or that of . . . [the respondents]" (Tr. 6964).

Furthermore, at the present stage of development of the art, there is a genuine question whether the rigid construction permit rule imposed by the court below, which appears to make issuance of a reactor operating license a relatively

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[13] See AEC Opinion, Tr. 6958-65, for summary of extent to which the Commission's practice with respect to provisional construction permits was brought to the attention of the Joint Committee on Atomic Energy in 1956 and again in 1958. Congress has taken no action to overturn this administrative practice, although the Atomic Energy Act of 1954 has been amended in some particulars at every session of Congress since its enactment. The Joint Committee occupies a unique role in that it is established by the Atomic Energy Act of 1954 itself, and Section 202 specifically enjoins the Commission to "keep the Joint Committee fully and currently informed with respect to all of the Commission's activities." App. C, p. 63. Compare *Panama Canal Co.* v. *Grace Line, Inc.*, 356 U.S. 309, 318-19.

automatic sequel to a construction permit, does not in the long run create more safety problems than it solves. The court appeared to read the Act as requiring "issuance of a license when the permitted construction is carried out" (App. B, p. 48). This may well be a safe and appropriate procedure when power reactors have become sufficiently standardized to justify issuance of commercial licenses under Section 103. In an area in which the technology is moving forward so rapidly, however, the wisdom from a safety standpoint of making a decision on the basis of information available in 1960, for example, to issue an operating license for an advanced developmental project to be completed in 1964 or 1965, would appear very dubious. This is the very type of question which the Commission, with the necessary expertise available to it, is much better qualified to resolve than are the courts, and the type of question which Congress plainly intended to entrust to the Commission's informed judgment.

II

IN HOLDING THAT THE COMMISSION MUST FIND "COMPELLING REASONS" TO JUSTIFY APPROVAL OF ANY REACTOR LOCATION WITHIN A REASONABLE DISTANCE OF POPULATED CENTERS, THE COURT BELOW HAS RENDERED A DECISION WHICH USURPS THE COMMISSION'S FUNCTION, OVERTURNS ITS CONSISTENT PRACTICE, AND FRUSTRATES ITS ADMINISTRATION OF THE ACT. SUCH DECISION CALLS FOR AN EXERCISE OF THIS COURT'S POWER OF SUPERVISION.

Another aspect of the decision below which has most serious implications for the nation's atomic power development program is that which holds the Commission's findings with respect to the reactor site deficient for failure to include what are called "compelling reasons" justifying the particular location. The court points to no provision of the statute or its legislative history requiring or even contemplating such a determination; rather, it indicates that in its judgment the fact that such location could expose "so large a population" to the mere *possibility* of nuclear

disaster makes such additional determination mandatory. No such "compelling reasons" have been found to support approval of any other reactor location, nor has such finding been considered by the Commission to be either necessary or appropriate.

That the court's holding as a practical matter amounts to imposition on the Commission of an arbitrary rule forbidding the location of large reactors in any populated area is indicated by the further statement that

> "We need not consider whether even the most compelling reasons for preferring this location could support a finding that the reactor could be operated at this location without 'undue' risk, or with 'adequate' protection, to the health and safety of the public." (App. B, p. 52).

It is important to note that in this aspect of its decision the majority of the court below is referring to "a typical large power reactor" and not to any unique characteristics of this particular project. The basic statements quoted with respect to theoretical or potential maximum danger to the population in the general vicinity of a large reactor are taken from the introduction to the Commission's so-called Brookhaven Report (Tr. 4853). This is a theoretical environmental analysis of general applicability to power reactors as such, and its conclusions are expressly subject to the numerous assumptions and limitations stated therein.[14] Similarly, the statement quoted in the opinion that there is a "possibility of a major disaster, even though it has a low probability", is taken from a statement initially made to a Congressional Committee by Dr. C. Rogers McCullough, former Chairman of the Commission's Advisory Committee on Reactor Safeguards, as part of his "general views on these questions of hazard evaluations" for reactors generally (Tr. 2999-3003).

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[14] Only the introduction (Tr. 4852-57) and a selected fragment of the text (Tr. 4885-92) of this extensive and highly technical report have been printed in the Joint Appendix. The entire report is included in the unprinted record on file in the office of the Clerk (Tr. 4852-5077).

The court below thus appears to have assumed the responsibility for making the overriding policy determination that, at least in the absence of some extraordinary justification, no power reactor is to be located in an area having a population density comparable to that found here.

First. The court plainly indicated that it considered the population distribution around the site to be the single disqualifying factor. It did not merely say that the potential extent of the harm which could theoretically result from an accident as a result of the population around a reactor location must be given due weight in determining whether the degree of protection provided against such accident by the "final design" of the reactor is adequate. That issue is not presented at this stage of the proceedings. The court's decision as a practical matter appears to direct the Commission simply not to locate *any* power reactor in an area of population density comparable to that found here, regardless of safeguards which may be provided and evaluated by the Commission as adequate, unless some "compelling reasons" for such location can be found. The imposition of such an arbitrary limitation usurps the Commission's function in the very field in which its expertise is of particular importance, puts in jeopardy all other comparable licenses and permits thus far issued, and would as a practical matter seriously retard the further development of nuclear reactors for the generation of electric power.

The exclusion area and population distribution around this reactor approximate those which the Commission has approved for other comparable power reactors. Appendix A to this petition (pp. 40-41 below) lists such relevant data as is publicly available with respect to all nine power reactors authorized thus far to be constructed or operated under the Act. Also listed are some four other comparable power reactors owned by the Commission (and therefore not required to be licensed) and built or being built in connection with publicly or privately owned electric generating facilities. Examination of these data will show that a number of these projects are larger or located in more populous areas than is the PRDC reactor, or both. A few

have slightly more favorable environmental characteristics in this particular. None, however, is located in the desert or other truly unpopulated area, several are placed as close or closer to metropolitan centers, and nearly all of them have substantially comparable population distribution characteristics. Reports on these projects are annually submitted to the Joint Congressional Committee on Atomic Energy in accordance with the provisions of Section 202 of the Act.[15]

Second. If Congress had intended to forbid the Commission to approve power reactors located in other than remote areas except under compelling or extraordinary circumstances, it would certainly have said so in specific terms. Nothing in the Act's provisions indicates such an intent. In view of the extensive hearings held, and of the fact that the Joint Committee on Atomic Energy in 1954 was certainly abreast of nuclear developments as a result of its years of work with the Commission in the administration of the Atomic Energy Act of 1946 [§15(b), 60 Stat. 772], Congress was plainly aware of the theoretical seriousness of a reactor accident and of the availability of containment and other designs to provide adequate protection of the public health and safety against such possible occurrence.[16] With this knowledge at hand, it vested *in the*

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[15] *E.g., Hearings Before the Joint Committee on Atomic Energy on Development, Growth and State of the Atomic Energy Industry*, 86th Cong., 2d Sess. (1960), pp. 14-15, 155-158, 489-90, 494-98, 524, 540-45, 548, 553-55, 556-80, 629-41.

[16] For example, in 1953, Dr. John C. Bugher, then Director, Division of Biology and Medicine, Atomic Energy Commission, testified that the possible or theoretical dangers of power reactors are such that "In the event of a serious disaster, the locality could be very seriously contaminated and would not be suitable for occupation by people for quite a period of time", although he believed that reactors could be so designed as to provide adequate protection against such an occurrence. *Hearings Before the Joint Committee on Atomic Energy on Atomic Power Development and Private Enterprise*, 83rd Cong., 1st Sess. (1953), pp. 32-34. An eminent physicist, Dr. Edward Teller, in a letter of July 23, 1953 to the Chairman of the Joint Committee on Atomic Energy, similarly indicated con-

Commission the authority to evaluate the various complex technical factors involved in approving reactor location.[17]

The legislative history of the 1954 Act shows that Congress was also quite aware that large reactors would be located, as in fact they have been, reasonably near large metropolitan centers. For example, Mr. Eugene Zuckert, then a member of the Atomic Energy Commission, testified at hearings on the bill in 1954 that large nuclear power plants (100,000 to 300,000 kilowatts or more) "are likely to be built first near heavy power-consuming centers", which he further described as "near but not in" metropolitan and industrial centers. II *Legis. Hist.* 2220. See also statement of Commissioner Smyth, *id.* at 2208.

In the debates Senator Lehman referred to such testimony when he noted that "the first nuclear reactors for power-producing purposes would very likely be erected in New York State, near the great centers of population in my State". III *Legis. Hist.* 3461. Senator Hennings voiced a similar understanding, that it was contemplated that "in the future, atomic-energy reactors of various sizes and capacities could be located in any city or town or, for that matter, in a barren field anywhere in the Middle West, as well as any place in the country." III *Legis. Hist.* 3681. Specific reference was made to proposed large power and test reactors, including the Shippingport reactor, since completed and now in operation at Shippingport, Pennsyl-

ceivable or possible fission product contamination of areas and populations around large reactors comparable to those subsequently elucidated in greater detail in the Brookhaven Report, quoted by the court below. He noted that it had therefore been the practice "to recommend the observance of exclusion distances, that is, to exclude the public from areas around reactors, the size of the area varying in appropriate manner with the amount of radioactive poison that the reactor might release". He obviously considered this a complex technological problem incapable of solution by arbitrary rules of thumb, and noted that in his opinion "reactors of sufficiently safe types might be developed in the near future." *Id.* at p. 633.

[17] See especially Section 161 i (3), which specifically empowers the Commission by regulation or order to fix "standards and restrictions governing the design, location, and operation" of authorized facilities, so as to "protect health and to minimize danger to life or property" (App. C, pp. 59-60).

vania, some 30 miles from the center of Pittsburgh (further described in Appendix A, p. 41, below). III *Legis. Hist.* 3660; Sen. Rep. No. 1699, I *Legis. Hist.* 751. See also III *Legis. Hist.* 3073.

Not only did these proposals evoke no statutory prohibition on the Commission's power to approve such projects, or to approve them only in extraordinary or compelling cases, but Congress actually wrote into Section 104 b of the Act a mandate to the Commission to lend developmental projects such as this one every encouragement and to impede them by a minimum of regulation (App. C, p. 58, below). The restriction imposed by the decision below constitutes a roadblock to nuclear progress of the very type which Congress in Section 104 b enjoined the Commission—and *a fortiori* the courts—not to erect. As Commissioner Zuckert properly pointed out in the 1954 Hearings on the Act (p. 29, above), if reactors are to be developed for the economic central station generation of electric power, they must be located, like most large conventional power plants, "near but not in" metropolitan and industrial centers.

Third. The alternative holding of the court with respect to reactor location was made on an issue not raised before the Commission or in the petition for review and in the face of an uncontested finding that the site was a suitable one.

On the only safety issue presented below, the respondents' argument was that the Commission had failed to make those findings with respect to the safety of this reactor at its proposed location which were claimed to be required by the regulations and the statute prior to issuance of a construction permit (discussed above, pp. 13-25).[18] No contention was advanced at any time that the site was unsuitable for *any* reactor of comparable size, or that the Commission must justify approval of such a location by finding "compelling reasons" for its selection.[19]

[18] See "Statement of Points" in respondents' Brief in Court of Appeals, p. 10 (filed with Clerk of this Court).

[19] At the hearing before the Commission the respondents contended that, because of the nature of this particular reactor, it or a prototype should first have been tested out in a remote location. On the basis of the evidence the Commission made a finding, not attacked here, that such a prototype had not been shown to be

Apart from the implications of such a contention, a valid explanation of why it was not urged to the court below is found in the fact that the Commission made plain, unambiguous and uncontested findings that this site *is* suitable for a power reactor of such size and type. In addition to the finding of reasonable assurance that a reactor of the general type proposed can be operated "at the location" without undue risk (Finding 22, Tr. 7020), the Commission also found that

> "There is reasonable assurance that the proposed site is generally suitable for a reactor of the type and size described in the Application, if the reactor is otherwise shown to be capable of operation without undue risk to the public health and safety, including demonstrations of stability and adequate containment" (Finding 32, Tr. 7023).[20]

This finding is neither quoted nor cited by the court below. Other findings with respect to site, some of which are so quoted, have to do largely with the development of further data with respect to meteorology, hydrology and

necessary (Finding 17, Tr. 7018). At no time did respondents question the suitability of the location for a power reactor as such. Compare *United States* v. *Tucker Truck Lines, Inc.*, 344 U.S. 33, 36-37; *Federal Power Commission* v. *Colorado Interstate Gas Co.*, 348 U.S. 492, 498-501.

[20] See also Finding 21, Tr. 7020. As the Brookhaven Report and the testimony referred to in the court's opinion recognize, it is undisputed that the potential or conceivable danger from any reactor lies not in the possibility of explosion or blast but in the accidental release to the environment of toxic fission products accumulated in it; every reactor creates such fission products in the course of operation, and their potential quantity is primarily a function of its size or power and secondarily of its general type. Tr. 3001-02, 3960, 3962-63. Hence, in initially approving the suitability of a site, the Commission must evaluate it, as it did here, in terms primarily of the size and type of the proposed reactor. Once the site is so approved, of course, the particular reactor must also be shown to be so designed, built and tested as to provide adequate protection against the possibility of release of fission products which it contains, or as the Commission put it here, that "no credible accident can release significant quantities of fission products into the atmosphere" (Finding 21, Tr. 7020).

the like. These data could indicate the necessity for additional protective measures or operating restrictions, but the undisputed testimony is that such further information, by its nature, could not render the site unsuitable for a large power reactor.[21] Hence the Commission's finding that the site was suitable for a reactor of this size and type, provided with adequate protective structures and devices, was definitive. As noted above, respondents chose in their petition for review in the court below not to attack this or any of the other safety findings as not supported by the evidence.

III

THE COMMISSION'S ORDER NEITHER "AGGRIEVES" THESE RESPONDENTS NOR IS IT "FINAL" AS TO THEM. IN HOLDING IT REVIEWABLE, THE COURT BELOW HAS RENDERED A DECISION IN CONFLICT WITH PRINCIPLES LAID DOWN BY THIS COURT AND ACCEPTED IN OTHER CIRCUITS.

Section 189 b of the Atomic Energy Act of 1954 (App. C, pp. 62-63) makes final orders of the Commission reviewable in accordance with the provisions of the Judicial Review Act of December 29, 1950, and of the Administrative Procedure Act. Sections 2 and 4 of the Judicial Review Act in turn give designated courts of appeals jurisdiction to review such final orders at the instance of "any party aggrieved" (App. C, pp. 63-64). Section 10 of the Administrative Procedure Act contains comparable provisions (*id.* at pp. 64-66).

Interpreting generally similar judicial review provisions of the Federal Communications Act, this Court has said that "jurisdiction depends upon standing to seek review and upon ripeness". *United States* v. *Storer Broadcasting Co.*, 351 U.S. 192, 197. Unless the Commission's order ag-

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[21] Tr. 3359-60, 4259 (not printed). The testimony is also undisputed that the extensive meteorological and other site data which the Commission requires prior to authorizing reactor operation and determining any limitations thereon, is information which, by its nature, takes several years to accumulate and in practically every instance is not fully available at the outset of construction but must be gathered as construction progresses. See *e.g.*, Tr. 3804, 4258-59 (not printed).

grieves or adversely affects the respondents, and unless it is final or "ripe" as to them, the court below had no jurisdiction to entertain their petition for review.

Admittedly, the only interest which the respondents here are entitled to protect is that of their members located in the general vicinity of the proposed reactor in not having their safety or property subjected to unreasonable hazard from its *operation*. The Commission found and the opinion below acknowledges that there has been no showing of injury from construction alone—the only activity authorized by the provisional construction permit. And before there can be any operation there must be a further hearing in which PRDC will have the burden of proof and in which the respondents may participate, and there must be a new decision, on the issue of the safety of operation of the plant as it is finally completed and tested.[22] The Commission made it as clear as it could that "[b]efore we authorize the issuance of an operating license to PRDC at a further reopening of this proceeding we will require that all safety questions be answered to our complete satisfaction, as required by the statute and our regulations" (Tr. 6938).

There is thus interposed between the Commission's construction permit order and any event which can adversely affect or aggrieve the respondents the necessity for a further proceeding, a new determination by the Commission on further evidence to be adduced, and a new order, all of which will be subject to further judicial review on the record then made. Under these circumstances the Commission's order complained of is not final or "ripe" as to these respondents, and because it is not ripe the order

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[22] See Findings 36, 37, Tr. 7023-24. This is further required by Section 189 a of the Act (as amended in 1957, 71 Stat. 579) which provides that "[t]he Commission shall hold a hearing after thirty days' notice and publication once in the Federal Register on each application under Section 103 or 104 b for a license for a facility. . . ." This was intended to include specifically the issuance of an operating license, and the Commission has uniformly so interpreted it. See also H. Rep. 435, 85th Cong., 1st Sess. (1957), p. 25.

itself does not now adversely affect or "aggrieve" them.[23]

This Court has made it plain that agency orders are not reviewable "unless and until they impose an obligation, deny a right or fix some legal relationship as a consummation of the administrative process." *Chicago & So. Air Lines, Inc.* v. *Waterman S.S. Corp.*, 333 U.S. 103, 113. They are not reviewable if "the complainant's rights are affected only on the contingency of future administrative action." *Columbia Broadcasting System, Inc.* v. *United States*, 316 U.S. 407, 420, citing *United States* v. *Los Angeles & S.L.R. Co.*, 273 U.S. 299, 309, 310; *cf. Eccles* v. *Peoples Bank of Lakewood Village*, 333 U.S. 426, 432-34. As a different division of the court below has succinctly put it, judicial review of such unripe orders is denied because "[i]t may well be, for all we are shown, that the [agency's] ultimate action will completely dispel every prospective fear voiced by" the complainant. *Associated Banning Co.* v. *United States*, 101 App. D.C. 151, 155, 247 F.2d 557, 561 (1957) (Miller, Danaher, Washington, JJ). Accord: *Howard Terminal* v. *United States*, 239 F.2d 336 (9th Cir. 1956).[24] In

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[23] Admittedly the plain language of Section 189 provides for judicial review of construction permit orders *if* they are "final" and result in "aggrievement". Many such construction permit orders would plainly meet these tests (*e.g.*, denial of a permit, grant of one of two conflicting permits, inclusion in a permit of an unacceptable condition, and the like). It is also undisputed that the respondents' interests could be sufficiently affected by actual operation of the proposed reactor to give them standing to review an order granting such authorization. No such order, of course, is involved here.

[24] The Court of Appeals for the Seventh Circuit has similarly held that, in order to be "aggrieved" within the meaning of these statutes, a party must show that the portions of the order complained of do genuine injury to his interests, so that his substantial rights have been or will be invaded by it; "[i]t is not sufficient that plaintiff as a member of the public desires a law to be correctly administered." *Railway Express Agency* v. *Kennedy*, 189 F. 2d 801, 804-05 (7th Cir. 1951), *cert. denied*, 342 U.S. 830. Other panels of the Court of Appeals for the District of Columbia Circuit have followed these same principles. *E.g.*, *Cincinnati Gas & Elec. Co.* v. *Federal Power Commission*, 101 App. D.C. 1, 7, 246 F. 2d 688, 694

its opinion the Commission itself made a determination, not excepted to on review, that its order issuing a provisional construction permit to PRDC "does not in any manner adversely affect the health and safety of the public or that of" the respondents (Tr. 6964). Compare *Panhandle Eastern Pipe Line Co.* v. *Federal Power Commission*, 219 F.2d 729 (3d Cir. 1955), *cert. denied*, 349 U.S. 945; *Interstate Electric, Inc.* v. *Federal Power Commission*, 164 F.2d 485, 485-86 (9th Cir. 1947).

The court below recognized that respondents had not claimed that construction alone would injure them. It nevertheless held the Commission's order reviewable on the theory that "construction would cause operation, and operation would cause injury" (App. B, p. 44). It based this conclusion on the Commission's findings (made in compliance with Section 50.35 of its regulations) of "reasonable assurance" that omitted technical information will be supplied and will prove to be sufficient to justify issuance of an operating license (Findings 31, 33, Tr. 7022-23). This, the court below said, makes it "probable, in a high degree, that if the construction permit stands PRDC will get an operating license" (App. B, p. 45). This in turn, the court said, makes the Commission's order now reviewable at the instance of these respondents.

It can readily be agreed that the Commission properly found a probability that the extensive research and development programs being conducted in connection with construction of the reactor will produce sufficient confirmation of its safety to permit it to be operated. The whole concept of Section 50.35 of the regulations is that, in order to justify issuance of a provisional construction permit, and to discourage projects that appear to have relatively little chance of success, the Commission must find "reasonable assurance" that the requisite technical data will be produced. The probability that it will prove possible to make the required showing of safety, however, is a

(1957) (Miller, Danaher, Bastian, JJ); *Aircoach Transport Ass'n* v. *Civil Aeronautics Board*, 103 App. D.C. 107, 255 F. 2d 185 (1958) (Washington, Bastian, Burger, JJ); *Wolff* v. *Benson*, 103 App. D.C. 334, 335, 258 F. 2d 428, 429 (1958) (Prettyman, Washington, Madden, JJ).

very different thing from the probability that the Commission will authorize operation *whether or not* such showing is made. Respondents here could be properly aggrieved by the Commission's order only if they could sustain the burden of showing at least the latter probability.

While the court below appeared to confuse these two questions, the essence of its holding is found in the tenet that, in spite of the uncontested findings of the Commission to the contrary and the unambiguous commitments of PRDC itself, the issuance of this provisional construction permit will inevitably result in possibly overwhelming pressure on the Commission to approve operation of the reactor whether or not this is adequately shown to be safe. As the opinion puts it (App. B, p. 50):

> "The economy cannot afford to invest enormous sums in the construction of an atomic reactor that will not be operated. If enormous sums are invested without assurance that the reactor can be operated with reasonable safety, pressure to permit operation without adequate assurance will be great and may be irresistible."

This is necessarily a suggestion that, as Judge Burger stated it, the members of the Atomic Energy Commission would be likely to disregard their responsibilities and oaths and "would permit an operation dangerous to the public because 40 or 50 million dollars is invested in brick, mortar and steel by men who knew from the outset they were engaged in a scientific gamble" (App. B, p. 54). And, of course, should such a miscarriage occur, "the courts are always in a position to exercise a final and stringent scrutiny on the issue of public safety." (*ibid.*).

The analysis suggested by the court below could in any event have validity only where the ultimate question is one of striking a fine balance between competing economic considerations in a mature industry in which a capital investment made under agency authority might conceivably exert a subtle influence on ultimate agency action. Compare *Community Broadcasting Co.* v. *Federal Communications Commission*, 274 F.2d 753 (App. D.C. 1960). This is the type of situation Senator Humphrey obviously had in mind

when he discussed "pressure" in the colloquy on the Senate floor, discussed above (pp. 20-22). It would have considerably less significance where the ultimate issue is the overriding one of public safety, even in connection with an application for a license for a purely commercial venture under Section 103 of the Act. When applied to the public safety of an admittedly non profit research and developmental project under Section 104 b of the Act, it is submitted that it has no force at all.

A research project by its nature is seeking not to return monetary profit on a capital investment but to push back the frontiers of knowledge. Everyone who undertakes such a project recognizes from the outset that the particular avenue of attack chosen may prove less successful than anticipated; yet if the attack is not made the answer may never be known. Research and experimentation (which in the nuclear field is traditionally and necessarily measured in millions or more) could not be undertaken on any other basis. If the technical information at hand when this reactor has been completed and subjected to stringent non-nuclear testing is not sufficient to enable the Commission to make the required finding that it can be operated, with or without power or other restrictions, in a manner which provides no undue risk to the health and safety of the public, it will certainly not be so operated. In such event, the extensive data obtained, including the knowledge that the particular design is not feasible and an understanding of the reasons therefor, will themselves constitute a valuable contribution to nuclear technology.

It would be hard to find a case in which the record is clearer that no potential pressure of the type feared exists or could be exerted. The Commission dealt with this quite forcefully in its opinion:

> "As we more fully discuss in Part II of this decision, PRDC has been on notice since before the first shovel of dirt was moved that its construction permit is *provisional* upon further demonstration of many technological and financial facts, including the complete safety of the reactor. The Applicant has, in fact, stated on the record that it is going to proceed at first under

only the construction permit so as to develop a background that will support assurance that the reactor can be operated in complete safety, and has stated its intention to seek operation authority only after all necessary facts have been assembled. Since PRDC has recognized the developmental nature of the reactor it is building and since it has expressly waived any commitment for an operating license (if there exists any of the type that the Intervenors [respondents] contend is implied by the construction permit), the possibility that the Commission would be in any way bound cannot be visualized. It would be hard to imagine a case where an applicant would be less able to argue that he had been misled by previous favorable Commission action. Under the circumstances of this case, moreover, and in view of the wording of the provisional construction permit, it is perfectly clear that PRDC is assuming a substantial financial risk with its eyes wide open, and that the generation of any pressure from such ingredients would be quite absurd." (Tr. 6956-57).

Again, respondents did not choose to attack these findings on review.

Under these circumstances, we think it is clear that this order, continuing in effect a provisional construction permit, providing for further review of the matter from time to time, if necessary, and for specific further proceedings in which a complete showing of safety of operation must be made at a new public hearing to be held prior to the issuance of an operating license, is in no sense an order "final" as to these respondents, nor does it "aggrieve" them, within the meaning of the review provisions of the applicable statutes. The petition for review of the Commission's order accordingly should have been dismissed.

CONCLUSION

A majority of the court below has pre-empted the roles of Congress and the Commission by writing into the law its particular ideas of what would be sound atomic energy

policy. It has done so with respect to matters that were not only plainly entrusted to the Atomic Energy Commission's expert discretion by Congress, but that fall in an area which, above all others, requires the evaluation of complex technical information by those specially qualified to do this. If this decision stands it will impede rather than further the plainly declared Congressional purpose of encouraging the most rapid development of the peaceful application of nuclear energy which is consistent with adequate protection of the public health and safety. In holding the provisional construction permit order of the Commission to be now reviewable at the instance of these respondents, the court below has also rendered a decision inconsistent with basic principles of judicial review laid down by this Court and accepted in other circuits.

The petition for certiorari should be granted and the judgment below reversed.

Respectfully submitted,

JOHN LORD O'BRIAN,
W. GRAHAM CLAYTOR, JR.,
701 Union Trust Building,
Washington 5, D. C.

EDWARD S. REID, JR.,
RICHARD B. GUSHEE,
3456 Penobscot Building,
Detroit 26, Michigan.

Attorneys for Petitioner
Power Reactor Development Company

COVINGTON & BURLING,
Washington, D.C.

MILLER, CANFIELD, PADDOCK AND STONE,
Detroit, Michigan

Of Counsel

AUGUST 12, 1960

APPENDIX A

POPULATION DATA WITH RESPECT TO AUTHORIZED POWER REACTORS[1]

Name of Reactor Project and Thermal Power (megawatts)	Status	Cumulative Population by Distance from Site (miles)					Nearest major city beyond 25 miles
		1[2]	5	10	20	25	
I. Privately Owned Section 104 b Developmental Power Reactors							
Consolidated Edison Co. of N.Y. Indian Point, N.Y. 795 megawatts	under construction CPPR–1, 21 Fed. Reg. 3084 (1956)	3,600	45,000	N.A.	N.A.	New York City limits 24 miles	New York
Commonwealth Edison Co. Morris, Ill. 626 megawatts	in operation CPPR–2, 21 Fed. Reg. 3085 (1956); DPR–2, 24 Fed. Reg. 8121 (1959)	N.A.	2,600	21,100	107,000	192,000	Chicago (downtown) 47 miles
General Electric Company Vallecitos, Calif. 30 megawatts	in operation CPPR–3, 21 Fed. Reg. 3395 (1956); DPR–1, 22 Fed. Reg. 7187 (1957)	N.A.	N.A.	22,000	N.A.	250,000	San Fran. 33 miles
Power Reactor Dev. Co. Lagoona Beach, Mich. 304 megawatts	under construction CPPR–4, Tr. 6933–7033	175	1,800	31,300	187,000	N.A.	Detroit 30 miles
Yankee Atomic Elec. Co. Rowe, Mass. 392 megawatts	in operation CPPR–5, 22 Fed. R 7188, 9237 (1957); DPR–3, 25 Fed. Reg. 6938 (1960)	174	2,036	28,982	104,293	N.A.	Albany 45 miles
Saxton Nuclear Exp. Proj. Saxton, Pa. 20 megawatts	under construction CPPR–6, 24 Fed. Reg. 9244, 25 *id.* 1471 (1960)	1,769	5,627	18,303	N.A.	Altoona, pop. 86,614, 22 miles	Altoona 22 miles
Carolinas-Va. Nuc. Pwr. Assn. Parr, S.C. 60.5 megawatts	under construction CPPR–7, 25 Fed. Reg. 522, 4206 (1960)	58	725	1,518	N.A.	104,671	Columbia 25 miles

Northern States Power Co. Sioux Falls, S.D. 303 megawatts	under construction CPPR–8, 25 Fed. Reg. 254, 4484 (1960)	N.A.	10,000	Sioux Falls, pop. 60,000 5.5 miles (center)	N.A.	N.A.	
Consumers Power Co. Big Rock Pt., Mich. 240 megawatts	under construction CPPR–9, 25 Fed. Reg. 1699, 5062 (1960)	5	4,964	9,000	26,700	N.A.	Sault Ste. Marie, 85 miles
II. Government Owned Developmental Power Reactors							
Shippingport Atomic Pwr. Stat. Shippingport, Pa. 231 megawatts	in operation since 1957	N.A.	20,000	125,000	(225,000, 0–15 miles)	N.A.	Pittsburgh (center) 30 miles
Rural Coop. Pwr. Assn. Elk River, Minn. 73 megawatts	under construction 24 Fed. Reg. 8280 (1959)	200	2,656	7,700	N.A.	N.A.	Minneapolis-St. Paul, 20–35 miles
City of Piqua Piqua, Ohio 45.5 megawatts	under construction 24 Fed. Reg. 8279 (1959)	4,000	21,000	42,000	N.A.	108,000	Dayton, 28 miles
Consumers Public Pwr. Dist. Hallam, Nebr. 254 megawatts	under construction 25 Fed. Reg. 1998 (1960)	21	1,052	6,768	(Lincoln, pop. 99,000, 19 miles)	N.A.	Omaha 65 miles

Note:

1. All location and power data are taken from Hearings, Joint Committee on Atomic Energy on Development, Growth and State of the Atomic Energy Industry, 86th Cong., 2d Sess. (1960), pp. 579–81. Data concerning the Shippingport reactor are taken from "WAPD–FC–547, Description of Shippingport Atomic Power Station Site and Surrounding Area" (1957) (unclassified). A few of the distances to distant cities are taken from the Rand McNally World Atlas (Premier Edition). The remaining data are derived from the license application or hazards summary reports on file in the AEC Public Document Room for each reactor. *"NA" indicates that the information in question was not readily available in the Public Document Room.*

2. Insofar as data on exclusion areas are available in the AEC Public Document Room, they indicate exclusion areas ranging from 150 acres to 950 acres for the above reactors except in one instance where there is an exclusion area of 1593 acres. The TRDC exclusion area is 915 acres (Exh. XXXIV, Tr. 5792) (not printed).

APPENDIX B

UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

No. 15271

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL-CIO; UNITED AUTOMOBILE, AIRCRAFT AND AGRICULTURAL IMPLEMENT WORKERS OF AMERICA; and UNITED PAPERMAKERS AND PAPERWORKERS, PETITIONERS

v.

UNITED STATES OF AMERICA and ATOMIC ENERGY COMMISSION, RESPONDENTS

POWER REACTOR DEVELOPMENT COMPANY, STATE OF MICHIGAN, INTERVENORS

ON PETITION TO REVIEW AN ORDER OF THE ATOMIC ENERGY COMMISSION

Decided June 10, 1960

Mr. Benjamin C. Sigal for petitioners.

Mr. Lionel Kestenbaum, Attorney Atomic Energy Commission, with whom *Assistant Attorney General Doub*, *Messrs. Loren K. Olson*, General Counsel, Atomic Energy Commission, *Courts Oulahan*, Special Assistant to the General Counsel, Atomic Energy Commission, and *Samuel D. Slade*, Attorney, Department of Justice, were on the brief, for respondents.

Mr. W. Graham Claytor, Jr., with whom *Mr. John Lord O'Brian* was on the brief, for intervenor Power Reactor Development Company.

Mr. Jerome Maslowski entered an appearance for intervenor State of Michigan.

Before EDGERTON, BAZELON, and BURGER, *Circuit Judges*.

EDGERTON, *Circuit Judge:* Petitioners seek review of the Atomic Energy Commission's Order of May 26, 1959 which continued in effect, with amendments, a "provi-

sional" construction permit issued August 4, 1956, for a nuclear power reactor. Section 104b of the Atomic Energy Act of 1954 authorizes the Commission to issue licenses for "utilization and production facilities involved in the conduct of research and development activities leading to the demonstration of the practical value of such facilities for industrial or commercial purposes. In issuing licenses under this subsection, the Commission shall impose the minimum amount of such regulations and terms of license as will permit the Commission to fulfill its obligations under this Act to promote the common defense and security and to protect the health and safety of the public. . . ." 68 Stat. 937, 42 U.S.C. § 2134(b).

The holder of the construction permit, intervenor here, is the Power Reactor Development Company (PRDC), a Michigan membership corporation organized "to study, develop, design, fabricate, construct and operate one or more experimental nuclear power reactors . . . to the end that there may be an early demonstration of the practical and economical use of nuclear energy for the generation of electrical energy. . . ." Of PRDC's 21 members, 14 are public utilities and 7 are equipment manufacturers.

The reactor will be the largest, but not the first, "fast breeder" reactor in the United States. The site is at Lagoona Beach, Monroe County, Michigan, on the shore of Lake Erie, 30 miles southwest of Detroit.

Petitioners' Standing

We cannot review the Commission's order at petitioners' request unless (1) it is a "final order" and (2) petitioners are "aggrieved" by it. Atomic Energy Act of 1954, § 189, 42 U.S.C. §2239(b); 5 U.S.C. §§ 1032, 1034. Although the Commission's action of May 26, 1959 was entitled "Commission's Opinion, Final Decision and Order," the Commission and PRDC now contend that the order was not final. They also contend that it did not aggrieve the petitioners. In our opinion it was what it purported to be, a final order, and petitioners are "aggrieved" by it. Because it threatens them with economic injury, they "had the requisite standing to appeal and to raise . . . any relevant question of law in respect of the order . . . ." *Federal Communications Commission* v. *Sanders Brothers Radio Station*, 309 U.S. 470, 477.

Petitioners are national or international labor unions which intervened, with some of their members, in the proceedings before the Commission, on the basis that "grant-

ing the conditional construction permit herein (1) is a violation of the provisions of the Atomic Energy Act of 1954, and the regulations pursuant thereto adopted by the Commission . . . and (2) will result in the construction of a reactor which, under present technological conditions, is inherently unsafe, and which will thereby create a hazard which will place the individual Intervenors, the members of the UAW and their families, and the UAW in danger of an explosion or other incident" damaging to the individuals and their homes, real estate values, and employment; that the value of collective bargaining contracts "will be seriously impaired if the PRDC reactor is built in this area without reasonable assurances of safety"; and that there are "reasonable grounds for relief that a license to operate said facility when it is completed, with an expenditure of $45,000,000 will be issued without proper consideration of and regard for the health and safety of the public."

In their reply brief in this court, petitioners contend that "The fear of a possible atomic catastrophe, in itself, before any operation would begin, would among other things have the effect of depressing values of property owned by the Petitioners, and would cause plants in which they work under collective bargaining agreements to move and thereby cause a loss of employment." Their reply brief asserts that "the uncontroverted allegations of their petition for intervention before the Commission set forth the economic injury they would suffer merely from the construction of the reactor itself." But we find no such allegations in their petition for intervention before the Commission. The theory of that petition was that construction would cause operation, and operation would cause injury, not that construction without operation would cause injury.[1] Judicial review is limited to the record before the Commission. 5 U.S.C. § 1037(a).

As the Commission says in its order, "a construction permit is a step toward a license rather than the equivalent thereof. . . . This permit is provisional to the extent that a license authorizing operation of the facility will not be issued by the Commission unless PRDC has submitted to the Commisssion (by proposed amendment to the Application) the complete, final Hazards Summary

[1] It is undisputed that construction without operation will cause no *physical* injury or danger not involved in the erection of any large building.

Report (portions of which may be submitted and evaluated from time to time), and the Commission has found that the final design provides reasonable assurance that the health and safety of the public will not be endangered by operation of the facility in accordance with the specified procedures. It is further provisional to the extent that the Commission reserves jurisdiction, at any time prior to issuance of an operating license, upon notice to the parties herein, to reopen this proceeding for the purpose of receiving additional evidence, and to make such determinations and take such action with respect to the continuance, vacation, or modification of this permit as the entire record warrants." But the order also says: "There is reasonable assurance that theoretical and experimental programs under way will develop sufficient data to justify the issuance of an operating license, and that the results of these programs will be available prior to the time it is necessary for the Commission to rule on the operating aspect of the PRDC license Application." PRDC says "it must be taken as settled . . . that the further technical information needed to complete the PRDC application for license will be supplied." Although this positive prediction overstates the matter, it is plainly probable, in a high degree, that if the construction permit stands PRDC will get an operating license and will operate. We think petitioners are therefore aggrieved by the issuance of the permit.

Safety Findings Required by the Atomic Energy Act

Petitioners contend that "The Act and the regulations of the Commission . . . require, as conditions precedent to the issuance of every construction permit for an atomic energy power reactor, that *as of the time the construction permit is issued* the Commission find that (1) it has reasonable assurance that the reactor may be constructed *and operated* at the proposed site without undue risk to the health and safety of the public . . . ."

It is undisputed that the Commission must make such a finding when it authorizes operation. The question is whether it must make such a finding when it authorizes construction. In our opinion it must.

Section 182 of the Atomic Energy Act of 1954, which is headed "License applications", provides in paragraph (a): ". . . In connection with applications for licenses to operate production or utilization facilities, the applicant shall state such technical specifications, including . . .

the place of the use . . . and such other information as the Commission may, by rule or regulation, deem necessary in order to enable it to find that the utilization or production of special nuclear material . . . will provide adequate protection to the health and safety of the public. Such technical specifications shall be a part of any license issued. . . ." 42 U.S.C. § 2232(a).

It seems to be unquestioned that the phrase used in § 182, "adequate protection to the health and safety of the public", and the Commission's phrase, "without undue risk to the health and safety of the public", are substantially equivalent.

Section 185 of the Act, which is headed "Construction permits", provides: "All applicants for licenses to construct or modify production or utilization facilities shall, if the application is otherwise acceptable to the Commission, be initially granted a construction permit. . . . Upon the completion of the construction or modification of the facility, upon the filing of any additional information needed to bring the original application up to date, and upon finding that the facility authorized has been constructed and will operate in conformity with the application as amended and in conformity with the provisions of this chapter and of the rules and regulations of the Commission, and in the absence of any good cause being shown to the Commission why the granting of a license would not be in accordance with the provisions of this Act, the Commission shall thereupon issue a license to the applicant. For all other purposes of this Act a construction permit is deemed to be a 'license'." 42 U.S.C. § 2235.

While the bill was pending, Senator Humphrey proposed, and withdrew, an amendment which would have added after the word "license", at the end of § 185: ", and no construction permit shall be issued by the Commission until after the completion of the procedures established by Section 182 for the consideration of applications for licenses under this act." (100 CONG. REC. 11566 (1954); Legislative History of the Atomic Energy Act of 1954, Vol. III, p. 3759; Vol. I, p. 733) He said: "*The purpose of the amendment* when it was prepared *was to make sure that the construction of a facility was not permitted prior to the authorization of a license,* because had that been done what it would have amounted to would be getting an investment of a substantial amount of capital, which surely would have been prejudicial in terms

of the Commission issuing the license. In other words, if the Commission had granted the construction permit for some form of nuclear reactor, and then the question of a license was not fully resolved, surely there would have been considerable pressure, and justifiably so, for the Commission to have authorized the license once it had authorized the permit for construction.

"The chairman of the committee tells me he has modified certain sections by the committee amendments to the bill, of which at that time I was not aware. *The chairman indicates to me that under the terms of the bill, as amended, the construction permit is equivalent to a license.* In other words, as I understand, under the bill a construction permit cannot be interpreted in any other way than being equal to or a part of the licensing procedure. Is that correct?" Senator Hickenlooper, the manager of the bill, replied: "The Senator is correct. The staff has worked on this matter. . . . A license and a construction permit are equivalent. . . . Therefore, we believe, and we assure the Senator, that *the amendment is not essential to the problem which he is attempting to reach.*" After some discussion of other sections of the bill, this colloquy occurred: "Mr. HUMPHREY. In other words, the revised sections on judicial review and on hearings and *the revised section 182 on license application all apply directly to construction permits? Mr.* HICKENLOOPER. *Yes.* Mr. HUMPHREY. *With that statement, Mr. President, I withdraw my amendment. The only purpose of the amendment was to clarify that section.* I am grateful to the chairman for having done it before the amendment was considered." (Emphasis added.) (100 CONG. REC. 11566; Legislative History, Vol. III, p. 3759.)[2]

If, as this indicates, § 182 applies "directly to" construction permits, when the Commission issues a construction permit it must "find that the utilization or production of special nuclear material . . . will provide adequate protection to the health and safety of the public"; or, in the Commission's phrase, that the facility can be "operated at the location proposed without undue risk to the health and safety of the public."

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[2] The Commission apparently interprets this colloquy as concerning only the "procedural safeguards" of notice, hearings, and appeal. We cannot so understand it and cannot suppose the Senate so understood it.

The Joint Committee on Atomic Energy said in its report on the bill: "Section 185 permits the Commission to issue construction permits to applicants for a production or utilization facility, describes the terms of the construction permit, and requires the issuance of a license if the construction is carried out in accordance with the terms of the construction permit." (S.Rep.No. 1699, 83d Cong., 2d Sess., 28 (1954); Legislative History, Vol. I, p. 776.) It seems certain that if the Act did not require, as a condition to the issuance of a construction permit, a finding that the proposed facility can be operated without undue risk to the health and safety of the public, the Act would not require the issuance of a license when the permitted construction is carried out.

At the very least it is doubtful whether the Commission's construction of the Atomic Energy Act is correct. The possibilities of harm are so enormous that any doubt as to what findings the Act requires, and any doubt as to whether the Commission made such findings, should be resolved on the side of safety.

The Commission's Safety Findings

In our opinion the Commission's findings regarding safety of operation are not sufficient.

An Initial Decision dated December 10, 1958, contains this unqualified finding: "22. The Commission finds reasonable assurance in the record that a utilization facility of the general type proposed in the PRDC application and amendments thereto can be constructed and will be able to be operated at the location proposed without undue risk to the health and safety of the public." But in the Opinion and Final Decision which accompanied its order of May 26, 1959, by interpolating the phrase we emphasize, the Commission qualified the finding: "22. The Commission finds reasonable assurance in the record, *for the purposes of this provisional construction permit*, that a utilization facility of the general type proposed in the PRDC Application and amendments thereto can be constructed and operated at the location without undue risk to the health and safety of the public." (Emphasis added.) This is not a finding that a facility can be operated there without undue risk. It is a finding that there is sufficient likelihood that a facility can be operated there without undue risk so that, in the Commission's opinion, it is appropriate to issue a "provisional" construction permit.

In our opinion such a finding does not meet the requirements of the Act.

The Commission made other statements which confirm the impression that it no longer found, as it had found in December, reasonable assurance that a facility can be operated at the location without undue risk. The Commission said: "The degree of 'reasonable assurance' with respect to safety that satisfies us in this case for purposes of the *provisional* construction permit would not be the same as we would require in considering the issuance of the *operating* license. . . . It has not been positively established that a fast breeder reactor of the general type and power level proposed by Applicant can be *operated* without a credible possibility of releasing significant quantities of fission products to the environment. . . ." (Emphasis in original.) And again: "*For the purposes of a provisional construction permit*, there is reasonable assurance that a reactor of the general type described in the Application can be so designed that no credible accident in the course of its operation is likely to result in the release of significant quantities of fission products into the atmosphere." (Emphasis added.)

The Commission expressed confidence that future scientific developments would enable it, in the future, to find that the reactor could be operated without undue risk. It said: "There is reasonable assurance that theoretical and experimental programs under way will develop sufficient data to justify the issuance of an operating license, and that the results of these programs will be available prior to the time it is necessary for the Commission to rule on the operating aspect of the PRDC license Application." "There is reasonable assurance that theoretical and experimental investigations which have been undertaken; together with operating experience on one or more of the EBR-I, EBR-II and Dounreay reactors, will establish definitely, prior to the scheduled completion date of the PRDC reactor, whether or not the reactor proposed by Applicant can be so operated"; *i.e.*, whether it can be "operated without a credible possibility of releasing significant quantities of fission products to the environment." Again, "there is reasonable assurance that *evidence will establish* that the reactor proposed by Applicant can be so operated." (Emphasis added.) This clearly implies that *evidence does not now establish* that the reactor can be so operated. The Commission's predictions regarding

the future course of scientific development do not in our opinion satisfy the requirement of the Act.

The Commission said: "It is in the nature of reactor design, although certainly not unique to it, that many features remain to be designed and demonstrated after construction is begun—and indeed some features redesigned and replaced after operation is under way. . . . By proceeding with construction and further research and development simultaneously, rather than awaiting complete research and development results Applicant will save several years in the time required to place in operation its demonstration power reactor." As a matter of policy, there is force in these considerations. But Congress seems to have been more impressed by the opposite policy considerations to which Senator Humphrey, in his colloquy with Senator Hickenlooper, called the attention of the Senate. The economy cannot afford to invest enormous sums in the construction of an atomic reactor that will not be operated. If enormous sums are invested without assurance that the reactor can be operated with reasonable safety, pressure to permit operation without adequate assurance will be great and may be irresistible. PRDC's estimate of the cost of construction, preconstruction research and development, and administrative expenses during construction and test operation was $44,020,000. The Commission found there would probably be "a cost over-run".

In contrast with the Commission's repeated expressions of uncertainty, it used other expressions which might seem to indicate a positive opinion regarding safety of operation. The Opinion and Final Decision, before adverting to the issue of safety and other issues, said broadly: "we amplify and affirm our Opinion and Initial Decision dated December 10, 1958." The Commission also said: "The principal factual issue in this proceeding is whether there is information sufficient to provide a reasonable assurance that a utilization facility of the general type proposed in the PRDC application can be constructed and operated at the location proposed therein without undue risk to the health and safety of the public. Subsidiary to this issue is whether there is reasonable assurance that technical information omitted from, and required to complete, the application will be supplied before issuance of an operating license. A careful evaluation of the entire record in this proceeding can only lead to an affirmative answer to all of these questions." And again: "It is enough for the purposes of the present proceeding (that is, for the issu-

ance of a provisional construction permit), and for the satisfaction of the requirements of the statute and the regulations, that there be reasonable assurance that the reactor can be constructed and operated without undue risk to the health and safety of the public. We conclude that the present state of knowledge as described in the record gives, and the accident possibilities presented on the record do not negate, that assurance."

It results that the Commission's findings regarding safety of operation are ambiguous. In view of the nature, size, and location of the project, we think the findings should be uncommonly free from ambiguity. The Commission should "make the basis of its action reasonably clear. We cannot find that it did so here." *Radio Station KFH Co.* v. *Federal Communications Commission*, 101 U.S.App.D.C. 164, 166, 247 F. 2d 570, 572. "'We must know what a decision means before the duty becomes ours to say whether it is right or wrong.'" *Secretary of Agriculture* v. *United States*, 347 U.S. 645, 654. *Pacific Far East Line, Inc.* v. *Federal Maritime Board*, —— U.S.App.D.C. ——, ——, 275 F. 2d 184, 187.

We think the Commission's safety findings are deficient in an additional respect.

In 1957 the Commission made to the Joint Committee on Atomic Energy "a report of a study of the possible consequences in terms of injury to persons and damage to property, if certain hypothetical major accidents should occur in a typical large nuclear power reactor." All the experts agreed "that the chances that major accidents might occur are exceedingly small." But "Under adverse combinations of the conditions considered, it was estimated that people could be killed at distances up to fifteen miles, and injured at distances of about forty-five miles. Land contamination could extend for greater distances." Undisputed testimony before the Commission shows that there is a "possibility of a major disaster, even though it has a low probability".

As the Commission said, "the question of safety obviously cannot be considered without regard to proposed location." The Commission found: "The site is bordered on one side by water and provides an exclusion area on the land side with a minimum radius of 2900 feet. The population distribution for given distances from the site is as follows: 1 mile, population 175; 2, 600; 5, 1,800; 10, 31,300; 20, 187,100; 30, 2,001,700. During the summer months the population within five miles would be increased

due to vacationing transients and to the fact that beaches two to five miles southwest of the site may be crowded with thousands of people."

We think it clear from the Congressional concern for safety that Congress intended no reactor should, without compelling reasons, be located where it will expose so large a population to the possibility of a nuclear disaster. It does not appear that the Commission found compelling reasons or saw that such reasons were necessary. It said: "The evidence of record with respect to site gives reasonable assurance that the site is satisfactory from structural and underground water flow standpoints. The meteorology of the site is complex, but no reason appears in the record for it to be disqualifying. The site makes possible extensive safeguards against the inadvertent release of liquid contaminants. . . . Studies of weather, hydrology, geology, and similar problems have yielded considerable information and are still in progress. Although the data of these types are not yet complete or conclusive, the record gives reasonable assurance that safe operation of the reactor will be as likely in that location as in any other location."[3] We think this finding clearly insufficient. We need not consider whether even the most compelling reasons for preferring this location could support a finding that the reactor could be operated at this location without "undue" risk, or with "adequate" protection, to the health and safety of the public.

Because we think the safety findings insufficient, we must set aside the Commission's grant of a construction permit and remand the case for such further proceedings consistent with this opinion as the Commission may determine. We need not consider other points raised by the petitioners.

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[3] The Commission continued: "We anticipate that knowledge to be acquired will fortify that assurance. . . . It is possible that there may be presently unknown effects in large fast reactor systems. A prototype of the proposed reactor at a remote location has been urged as affording greater assurance against the possibility of such unknown effects than does the presently planned experimental and theoretical programs. (sic) The Commission finds that the necessity, however, for constructing such a prototype has not been shown. If the program of meltdown investigation should prove inconclusive, it will be necessary to reconsider the question of need for a prototype."

BURGER, *Circuit Judge, dissenting:* I dissent because I think there is no occasion at this time for the court to reach the issue of the ultimate safety of the plant's operations. The Commission has issued only a provisional permit to build a plant, not to operate it. The plant cannot go into operation until and unless the intervenor PRDC meets the safety provisions of the Act.

The sole basis of challenge to the provisional construction permit is that the *future possibility* that an operating permit will be unlawfully and improperly issued by the Commission creates a "present," "immediate" and "unavoidable threat" of injury. I do not think we have any occasion to consider what is not now before us. The Commission expressly deferred action on that issue. This does not appear to me a "final order" which gives us jurisdiction to pass on the ultimate issue of safety; nor does it empower us to tell the Commission that it must pass on the ultimate safety of the operaion before the plant is constructed. Orders are not final as to a person "unless and until they impose an obligation, deny a right or fix some legal relationship as a consummation of the administrative process." *Chicago & Southern Air Lines, Inc.* v. *Waterman Steamship Corp.*, 333 U.S. 103, 113 (1948).

In an area involving as much scientific uncertainty as development of nuclear energy for peaceful purposes, the Commission must be permitted to proceed step by step, *i.e.*, make its preliminary finding of probable safety when the construction permit issues and reserve final approval of operations until a later date.

I respectfully suggest that my colleagues are undertaking to assume responsibilities which Congress vested in the Commission. This is illustrated in the majority's statement

> "No reactor should, without compelling reasons, be located where it will expose so large a population to the possibility of a nuclear disaster."

On what evidence does the majority make a finding of "nuclear disaster" directly opposed to the finding which the Atomic Energy Commission made? The majority is, in effect, telling the Atomic Energy Commission that it has made an *unwise* decision on the location of the plant.

The majority also goes beyond the established limits of judicial review when it states:

> "The economy cannot afford to invest enormous sums in the construction of an atomic reactor that will not

be operated. If enormous sums are invested without assurance that the reactor can be operated with reasonable safety, pressure to permit operation without adequate assurance will be great and may be irresistible."

From an erroneous premise drawn out of thin air, the majority proceeds to draw an unwarranted conclusion. On what evidence can we as judges say our "economy cannot afford," or even that these appellees cannot afford, this large investment for peaceful uses of nuclear energy? I suggest our entire history is to the contrary. We invested not mere millions but *billions* in the original development of nuclear fission on a totally unproven theory of physics. It was an act of faith in the views of scientists. Surely it cannot be seriously suggested that these giants of American industry which formed PRDC are not well able—and willing—to risk the loss of millions in experiments and research. Forty or fifty million dollars to the sponsors of PRDC is a small investment to risk for the world's first known experiment of this kind into peaceful uses of nuclear energy.

If we were dealing with a radio or TV license or some other purely commercial enterprise in a developed and mature industry I would agree that there is a risk that large investment in machines might conceivably exert a subtle influence on the ultimate grant of an operations permit. Cf. *Community Broadcasting Co.* v. *Federal Communications Commission*, Nos. 15313, 15314 (D.C.Cir., Feb. 8, 1960). But I cannot join in the suggestion that members of the Atomic Energy Commission who have assumed obligations under oaths as binding as ours would permit an operation dangerous to the public because 40 or 50 million dollars is invested in brick, mortar and steel by men who knew from the outset they were engaged in a scientific gamble. And if any administrative agency should so abdicate its responsibilities in a matter as grave as this—which I cannot believe is likely—the courts are always in a position to exercise a final and stringent scrutiny on the issue of public safety.

Development in an area like this must, of necessity, proceed step by step. The Commission has found that the issuance of the construction permit on a provisional and restricted basis "does not in any manner adversely affect the health and safety of the public or that of the [petitioners]." The appellants do not attack this finding.

At this stage how can anyone know what the result will be? This court considered a challenge not unlike that of appellants' challenge in *Associated-Banning Co.* v. *United States*, 247 F.2d 557, 561 (1957): "We cannot assume that the Board will not conduct its hearing within the intendment of the Act, so far as it may apply. It may well be, for all we are shown, that the Board's ultimate action will completely dispel every prospective fear voiced by the protest and the complaint. It is clear that the Board has not as yet entered an order 'final' as to these petitioners."

The essence of the majority action is found in its acceptance of the idea that once the Commission has permitted PRDC to invest its millions in the plant they are "bound" or "likely" to relax their notion of what is safe or dangerous in order to bail out the investors.

I emphasize that I cannot for a moment believe the sponsors of PRDC are so naive that they would think their investment of these millions is not speculative just as is most research. Nor can I believe they think that any amount of invested capital will persuade the Atomic Energy Commission to make a finding of safety which is not supported by substantial scientific evidence. It is entirely possible that PRDC might find itself the owner of a 50 million dollar scientific "white elephant" if, after completion of construction, it cannot satisfy the safety standards of the statute. Should that be the case it will be simply one of the unproductive steps in what promises to be a program to open to mankind sources of power undreamed of only a few years ago.

APPENDIX C

I. Pertinent Provisions of Statutes

1. ATOMIC ENERGY ACT OF 1954, AS AMENDED, SECTIONS 1, 3a, d, 101, 102, 103, 104, 161 b, i, p, 182, 185, 189, 202, 68 STAT. 924, 922, 936, 937, 948, 953, 955, 956, 70 STAT. 1070, 1071 71 STAT. 579, 42 U.S.C. §§ 2011, 2013(a), (d), 2131, 2132, 2133, 2134, 2201(b), (i), (p), 2232, 2235, 2239, 2252.

Section 1. Declaration.—Atomic energy is capable of application for peaceful as well as military purposes. It is therefore declared to be the policy of the United States that—

a. the development, use, and control of atomic energy shall be directed so as to make the maximum contribution to the general welfare, subject at all times to the paramount objective of making the maximum contribution to the common defense and security; and

b. the development, use, and control of atomic energy shall be directed so as to promote world peace, improve the general welfare, increase the standard of living, and strengthen free competition in private enterprise.

* * * *

Sec. 3. Purpose.—It is the purpose of this Act to effectuate the policies set forth above by providing for—

a. a program of conducting, assisting, and fostering research and development in order to encourage maximum scientific and industrial progress;

* * * *

d. a program to encourage widespread participation in the development and utilization of atomic energy for peaceful purposes to the maximum extent consistent with the common defense and security and with the health and safety of the public;

* * * *

Sec. 101. License Required.—It shall be unlawful, except as provided in section 91, for any person within the United States to transfer or receive in interstate commerce, manufacture, produce, transfer, acquire, possess, use, import, or export any utilization or production facility except under and in accordance with a license issued by the Commission pursuant to section 103 or 104.

SEC. 102. FINDING OF PRACTICAL VALUE.—Whenever the Commission has made a finding in writing that any type of utilization or production facility has been sufficiently developed to be of practical value for industrial or commercial purposes, the Commission may thereafter issue licenses for such type of facility pursuant to section 103.

SEC. 103. COMMERCIAL LICENSES.—

a. Subsequent to a finding by the Commission as required in section 102, the Commission may issue licenses to transfer or receive in interstate commerce, manufacture, produce, transfer, acquire, possess, use, import, or export under the terms of an agreement for cooperation arranged pursuant to section 123, such type of utilization or production facility. Such licenses shall be issued in accordance with the provisions of chapter 16 and subject to such conditions as the Commission may by rule or regulation establish to effectuate the purposes and provisions of this Act.

b. The Commission shall issue such licenses on a nonexclusive basis to persons applying therefor (1) whose proposed activities will serve a useful purpose proportionate to the quantities of special nuclear material or source material to be utilized; (2) who are equipped to observe and who agree to observe such safety standards to protect health and to minimize danger to life or property as the Commission may by rule establish; and (3) who agree to make available to the Commission such technical information and data concerning activities under such licenses as the Commission may determine necessary to promote the common defense and security and to protect the health and safety of the public. All such information may be used by the Commission only for the purposes of the common defense and security and to protect the health and safety of the public.

c. Each such license shall be issued for a specified period, as determined by the Commission, depending on the type of activity to be licensed, but not exceeding forty years, and may be renewed upon the expiration of such period.

d. No license under this section may be given to any person for activities which are not under or within the jurisdiction of the United States, except for the export of production or utilization facilities under terms of an

agreement for cooperation arranged pursuant to section 123, or except under the provisions of section 109. No license may be issued to an alien or any corporation or other entity if the Commission knows or has reason to believe it is owned, controlled, or dominated by an alien, a foreign corporation, or a foreign government. In any event, no license may be issued to any person within the United States if, in the opinion of the Commission, the issuance of a license to such person would be inimical to the common defense and security or to the health and safety of the public.

SEC. 104. MEDICAL THERAPY AND RESEARCH AND DEVELOPMENT.—

a. The Commission is authorized to issue licenses to persons applying therefor for utilization facilities for use in medical therapy. In issuing such licenses the Commission is directed to permit the widest amount of effective medical therapy possible with the amount of special nuclear material available for such purposes and to impose the minimum amount of regulation consistent with its obligations under this Act to promote the common defense and security and to protect the health and safety of the public.

b. The Commission is authorized to issue licenses to persons applying therefor for utilization and production facilities involved in the conduct of research and development activities leading to the demonstration of the practical value of such facilities for industrial or commercial purposes. In issuing licenses under this subsection, the Commission shall impose the minimum amount of such regulations and terms of license as will permit the Commission to fulfill its obligations under this Act to promote the common defense and security and to protect the health and safety of the public and will be compatible with the regulations and terms of license which would apply in the event that a commercial license were later to be issued pursuant to section 103 for that type of facility. In issuing such licenses, priority shall be given to those activities which will, in the opinion of the Commission, lead to major advances in the application of atomic energy for industrial or commercial purposes.

c. The Commission is authorized to issue licenses to persons applying therefor for utilization and produc-

tion facilities useful in the conduct of research and development activities of the types specified in section 31 and which are not facilities of the type specified in subsection 104b. The Commission is directed to impose only such minimum amount of regulation of the licensee as the Commission finds will permit the Commission to fulfill its obligations under this Act to promote the common defense and security and to protect the health and safety of the public and will permit the conduct of widespread and diverse research and development.

d. No license under this section may be given to any person for activities which are not under or within the jurisdiction of the United States, except for the export of production or utilization facilities under terms of an agreement for cooperation arranged pursuant to section 123 or except under the provisions of section 109. No license may be issued to any corporation or other entity if the Commission knows or has reason to believe it is owned, controlled, or dominated by an alien, a foreign corporation, or a foreign government. In any event, no license may be issued to any person within the United States if, in the opinion of the Commission, the issuance of a license to such person would be inimical to the common defense and security or to the health and safety of the public.

* * * * *

SEC. 161. GENERAL PROVISIONS.—In the performance of its functions the Commission is authorized to—

* * * * *

b. establish by rule, regulation, or order, such standards and instructions to govern the possession and use of special nuclear material, source material, and byproduct material as the Commission may deem necessary or desirable to promote the common defense and security or to protect health or to minimize danger to life or property;

* * * * *

i. prescribe such regulations or orders as it may deem necessary (1) to protect Restricted Data received by any person in connection with any activity authorized pursuant to this Act, (2) to guard against the loss or diversion of any special nuclear material acquired by any person pursuant to section 53 or produced by

any person in connection with any activity authorized pursuant to this Act, and to prevent any use or disposition thereof which the Commission may determine to be inimical to the common defense and security, and (3) to govern any activity authorized pursuant to this Act, including standards and restrictions governing the design, location, and operation of facilities used in the conduct of such activity, in order to protect health and to minimize danger to life or property;

* * * * *

p. make, promulgate, issue, rescind, and amend such rules and regulations as may be necessary to carry out the purposes of this Act;

* * * * *

SEC. 182. LICENSE APPLICATIONS.—

a. Each application for a license hereunder shall be in writing and shall specifically state such information as the Commission, by rule or regulation, may determine to be necessary to decide such of the technical and financial qualifications of the applicant, the character of the applicant, the citizenship of the applicant, or any other qualifications of the applicant as the Commission may deem appropriate for the license. In connection with applications for licenses to operate production or utilization facilities, the applicant shall state such technical specifications, including information of the amount, kind, and source of special nuclear material required, the place of the use, the specific characteristics of the facility, and such other information as the Commission may, by rule or regulation, deem necessary in order to enable it to find that the utilization or production of special nuclear material will be in accord with the common defense and security and will provide adequate protection to the health and safety of the public. Such technical specifications shall be a part of any license issued. The Commission may at any time after the filing of the original application, and before the expiration of the license, require further written statements in order to enable the Commission to determine whether the application should be granted or denied or whether a license should be modified or revoked. All applications and statements shall be signed by the applicant or licensee. Appli-

cations for, and statements made in connection with, licenses under sections 103 and 104 shall be made under oath or affirmation. The Commission may require any other applications or statements to be made under oath or affirmation.

b. The Advisory Committee on Reactor Safeguards shall review each application under section 103 or 104 b. for a license for a facility, any application under section 104 c. for a testing facility, and any application under section 104 a. or c. specifically referred to it by the Commission, and shall submit a report thereon, which shall be made part of the record of the application and available to the public, except to the extent that security classification prevents disclosure.[1]

c. The Commission shall not issue any license for a utilization or production facility for the generation of commercial power under section 103, until it has given notice in writing to such regulatory agency as may have jurisdiction over the rates and services of the proposed activity, to municipalities, private utilities, public bodies, and cooperatives within transmission distance authorized to engage in the distribution of electric energy and until it has published notice of such application once each week for four consecutive weeks in the Federal Register, and until four weeks after the last notice.

d. The Commission, in issuing any license for a utilization or production facility for the generation of commercial power under section 103, shall give preferred consideration to applications for such facilities which will be located in high cost power areas in the United States if there are conflicting applications for a limited opportunity for such license. Where such conflicting applications resulting from limited opportunity for such license include those submitted by public or cooperative bodies such applications shall be given preferred consideration.

* * * * *

[1] This subsection was added and original subsections "b" and "c" were relettered respectively "c" and "d" by P.L. 85-256, 71 Stat. 576 (1957).

SEC. 185. CONSTRUCTION PERMITS.—All applicants for licenses to construct or modify production or utilization facilities shall, if the application is otherwise acceptable to the Commission, be initially granted a construction permit. The construction permit shall state the earliest and latest dates for the completion of the construction or modification. Unless the construction or modification of the facility is completed by the completion date, the construction permit shall expire, and all rights there under be forfeited, unless upon good cause shown, the Commission extends the completion date. Upon the completion of the construction or modification of the facility, upon the filing of any additional information needed to bring the original application up to date, and upon finding that the facility authorized has been constructed and will operate in conformity with the application as amended and in conformity with the provisions of this Act and of the rules and regulations of the Commission, and in the absence of any good cause being shown to the Commission why the granting of a license would not be in accordance with the provisions of this Act, the Commission shall thereupon issue a license to the applicant. For all other purposes of this Act, a construction permit is deemed to be a "license."

* * * *

SEC. 189. HEARINGS AND JUDICIAL REVIEW.—

a. In any proceeding under this Act, for the granting, suspending, revoking, or amending of any license or construction permit, or application to transfer control, and in any proceeding for the issuance or modification of rules and regulations dealing with the activities of licensees, and in any proceeding for the payment of compensation, an award or royalties under sections 153, 157, 186 c., or 188, the Commission shall grant a hearing upon the request of any person whose interest may be affected by the proceeding, and shall admit any such person as a party to such proceeding. The Commission shall hold a hearing after thirty days' notice and publication once in the Federal Register on each application under section 103 or 104 b. for a license for a facility, and on any application under section 104 c. for a license for a testing facility.[1]

b. Any final order entered in any proceeding of the kind specified in subsection a. above shall be subject to judicial review in the manner prescribed in the Act of December

[1] The last sentence of Sec. 189 a was added by P.L. 85-256, 71 Stat. 576 (1957).

29, 1950, as amended (ch. 1189, 64 Stat. 1129), and to the provisions of section 10 of the Administrative Procedure Act, as amended.

* * * *

SEC. 202. AUTHORITY AND DUTY.—The Joint Committee shall make continuing studies of the activities of the Atomic Energy Commission and of problems relating to the development, use, and control of Atomic energy. During the first sixty days of each session of the Congress, the Joint Committee shall conduct hearings in either open or executive session for the purpose of receiving information concerning the development, growth, and state of the atomic energy industry. The Commission shall keep the Joint Committee fully and currently informed with respect to all of the Commission's activities. The Department of Defense shall keep the Joint Committee fully and currently informed with respect to all matters within the Department of Defense relating to the development, utilization, or application of atomic energy. Any Government agency shall furnish any information requested by the Joint Committee with respect to the activities or responsibilities of that agency in the field of atomic energy. All bills, resolutions, and other matters in the Senate or the House of Representatives relating primarily to the Commission or to the development, use, or control of atomic energy shall be referred to the Joint Committee. The members of the Joint Committee who are Members of the Senate shall from time to time report to the Senate, and the members of the Joint Committee who are Members of the House of Representatives shall from time to time report to the House, by bill or otherwise, their recommendations with respect to matters within the jurisdiction of their respective Houses which are referred to the Joint Committee or otherwise within the jurisdiction of the Joint Committee.

2. *JUDICIAL REVIEW ACT OF DECEMBER 29, 1950, AS AMENDED, SECTIONS 2, 4, 64 STAT. 1129, 1130, 68 STAT. 961, 5 U. S. C. §§ 1032, 1034.*

* * * *

SEC. 2. The court of appeals shall have exclusive jurisdiction to enjoin, set aside, suspend (in whole or in part), or to determine the validity of, all final orders (a) of the Federal Communications Commission made reviewable in accordance with the provisions of section 402 (a) of the Communications Act of 1934, as amended, and (b) of the

Secretary of Agriculture made under the Packers and Stockyards Act, 1921, as amended, and under the Perishable Agricultural Commodities Act, 1930, as amended, except orders issued under sections 309 (e) and 317 of the Packers and Stockyards Act and section 7 (a) of the Perishable Agricultural Commodities Act, and (c) such final orders of the United States Maritime Commission or the Federal Maritime Board or the Maritime Administration entered under authority of the Shipping Act, 1916, as amended, and the Intercoastal Shipping Act, 1933, as amended, as are now subject to judicial review pursuant to the provisions of section 31, Shipping Act, 1916, as amended, and (d) of the Atomic Energy Commission made reviewable by section 189 of the Atomic Energy Act of 1954, as amended.

Such jurisdiction shall be invoked by the filing of a petition as provided in section 4 hereof.

* * * * *

SEC. 4. Any party aggrieved by a final order reviewable under this Act may, within sixty days after entry of such order, file in the court of appeals, wherein the venue as prescribed by section 3 hereof lies, a petition to review such order. Upon the entry of such an order, notice thereof shall be given promptly by the agency by service or publication in accordance with the rules of such agency. The action in court shall be brought against the United States. The petition shall contain a concise statement of (a) the nature of the proceedings as to which review is sought, (b) the facts upon which venue is based, (c) the grounds on which relief is sought, and (d) the relief prayed. The petitioner shall attach to the petition, as exhibits, copies of the order, report, or decision of the agency. The clerk shall serve a true copy of the petition upon the agency and upon the Attorney General of the United States by mailing by registered mail, with request for return receipt, a true copy to the agency and a true copy to the Attorney General.

3. ADMINISTRATIVE PROCEDURE ACT, SECTION 10, 60 STAT. 243, 5 U.S.C. § 1009.

SEC. 10. Except so far as (1) statutes preclude judicial review or (2) agency action is by law committed to agency discretion—

(a) RIGHT OF REVIEW.—Any person suffering legal wrong because of any agency action, or adversely affected or

aggrieved by such action within the meaning of any relevant statute, shall be entitled to judicial review thereof.

(b) FORM AND VENUE OF ACTION.—The form of proceeding for judicial review shall be any special statutory review proceeding relevant to the subject matter in any court specified by statute or, in the absence or inadequacy thereof, any applicable form of legal action (including actions for declaratory judgments or writs of prohibitory or mandatory injunction or habeas corpus) in any court of competent jurisdiction. Agency action shall be subject to judicial review in civil or criminal proceedings for judicial enforcement except to the extent that prior, adequate, and exclusive opportunity for such review is provided by law.

(c) REVIEWABLE ACTS.—Every agency action made reviewable by statute and every final agency action for which there is no other adequate remedy in any court shall be subject to judicial review. Any preliminary, procedural, or intermediate agency action or ruling not directly reviewable shall be subject to review upon the review of the final agency action. Except as otherwise expressly required by statute, agency action otherwise final shall be final for the purposes of this subsection whether or not there has been presented or determined any application for a declaratory order, for any form of reconsideration, or (unless the agency otherwise requires by rule and provides that the action meanwhile shall be inoperative) for an appeal to superior agency authority.

(d) INTERIM RELIEF.—Pending judicial review any agency is authorized, where it finds that justice so requires, to postpone the effective date of any action taken by it. Upon such conditions as may be required and to the extent necessary to prevent irreparable injury, every reviewing court (including every court to which a case may be taken on appeal from or upon application for certiorari or other writ to a reviewing court) is authorized to issue all necessary and appropriate process to postpone the effective date of any agency action or to preserve status or rights pending conclusion of the review proceedings.

(e) SCOPE OF REVIEW.—So far as necessary to decision and where presented the reviewing court shall decide all relevant questions of law, interpret constitutional and statutory provisions, and determine the meaning or applicability of the terms of any agency action. It shall (A) compel agency action unlawfully withheld or unreasonably de-

layed; and (B) hold unlawful and set aside agency action, findings, and conclusions found to be (1) arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law; (2) contrary to constitutional right, power, privilege, or immunity; (3) in excess of statutory jurisdiction, authority, or limitations, or short of statutory right; (4) without observance of procedure required by law; (5) unsupported by substantial evidence in any case subject to the requirements of sections 7 and 8 or otherwise reviewed on the record of an agency hearing provided by statute; or (6) unwarranted by the facts to the extent that the facts are subject to trial de novo by the reviewing court. In making the foregoing determinations the court shall review the whole record or such portions thereof as may be cited by any party, and due account shall be taken of the rule of prejudicial error.

II. Pertinent Provisions of Regulations

Section 50.34. *Contents of applications; technical information hazards summary report.* Each application shall state the following technical information:

(a) A description of the chemical, physical, metallurgical, or nuclear process to be performed, and a statement of the kind and quantity of any radioactive effluent expected to result from the process. The description of the process should be sufficiently detailed to permit evaluation of the radioactive hazards involved. The magnitude of the proposed operation should be indicated in terms of the amount and radioactivity of source, special nuclear, or by-product material to be handled per unit of time, and thermal power to be generated if any.

(b) A description of the facility. The description should be based on the design criteria for the facility as a whole and for those major component parts which are essential to the safe operation of the facility, and should be presented in sufficient detail to allow an evaluation of the adequacy of the various means proposed to minimize the probability of danger from radioactivity to persons both on and off-site. The description should also cover any activities, other than those subject to license, proposed to be carried on in the building which will house the facility and on the balance of the site.

(c) A description of the site on which the facility is to be located. This should include a map of the area show-

ing the location of the site and indicating the use to which the surrounding land is put, i.e., industrial, commercial, agricultural, residential; location of sources of potable or industrial water supply, watershed areas and public utilities; and a scale plot plan of the site showing the proposed location of the facility.

(d) A description of proposed procedures for: routine and non-routine operations, start-up and shut-down, maintenance, storage, training of employees, minimizing operational mishaps (such as locked controls, checklists, and close supervision), investigating unusual or unexpected incidents; and a description of such other details as may be useful in evaluating the existence and effectiveness of safeguards against the radioactive hazards in the operation of the facility.

(e) A description of plans or proposals in the event that acts or accidents occur which would create radioactive hazards. The description should relate the various operational procedures, the protective devices, and the pertinent features of the site, to such happenings as operational mistakes, equipment or instrument failure or malfunction, fire, electric power failure, flood, earthquake, storm, strike, and riot.

(f) Meteorological, hydrological, geological, and seismological data necessary for evaluating the measures proposed for protecting the public against possible radioactive hazards.

(g) An evaluation of the proposed measures and devices to prevent acts or accidents which would create radioactive hazards or to protect against the consequences should such acts or accidents occur.

(h) A description of procedures for disposal of radioactive solid waste and the final disposal of liquid waste effluent.

(i) A description of means provided to sample atmosphere discharges through stacks where such stacks may emit by-product material or special nuclear material.

SECTION 50.35. *Extended time for providing technical information.* Where, because of the nature of a proposed project, an applicant is not in a position to supply initially all of the technical information otherwise required to complete the application, he shall indicate the reason, the items or kinds of information omitted, and the approximate times when such data will be produced. If the Commission is satisfied that it has information suffi-

cient to provide reasonable assurance that a facility of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public and that the omitted information will be supplied, it may process the application and issue a construction permit on a provisional basis without the omitted information subject to its later production and an evaluation by the Commission that the final design provides reasonable assurance that the health and safety of the public will not be endangered.

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No. —

In the Supreme Court of the United States

OCTOBER TERM 1960

UNITED STATES OF AMERICA AND ATOMIC ENERGY COMMISSION, PETITIONERS

v.

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL–CIO, ET AL.

PETITION FOR A WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

J. LEE RANKIN,
Solicitor General,
GEORGE COCHRAN DOUB,
Assistant Attorney General,
MORTON HOLLANDER,
Attorney, Department of Justice, Washington 25, D.C.

D. NAIDEN,
General Counsel,
OULAHAN,
General Counsel,
KESTENBAUM,
Atomic Energy Commission, Washington 25, D.C.

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In the Supreme Court of the United States

OCTOBER TERM 1960

No. —

UNITED STATES OF AMERICA AND ATOMIC ENERGY COMMISSION, PETITIONERS

v.

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL–CIO, ET AL.

PETITION FOR A WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

The Solicitor General, on behalf of the United States of America and the Atomic Energy Commission, petitions for a writ of certiorari to review the judgment of the United States Court of Appeals for the District of Columbia Circuit entered in the above case on June 10, 1960.[1]

OPINION BELOW

The opinion of the court of appeals (Appendix *infra*, pp. 31–49) is not yet reported. The opinion of

[1] A petition for a writ of certiorari to review the judgment below has already been filed by the Power Reactor Development Company, No. 315, this Term.

the Atomic Energy Commission is set forth at Tr. 6933–7024.[2]

JURISDICTION

The judgment of the court of appeals was entered on June 10, 1960 (App. *infra*, p. 65), and petitions for rehearing *en banc* were denied on July 25, 1960 (App., *infra*, pp. 66–67). The jurisdiction of this Court is invoked under 5 U.S.C. 1040, and 28 U.S.C. 1254(1).

QUESTIONS PRESENTED

1. Whether the Atomic Energy Act of 1954 precludes the Atomic Energy Commission from approving a site for an atomic power reactor that is close to a populated area—based on Commission findings that the site is suitable for a reactor of the general type and that there is reasonable assurance that its operation there would not cause undue risk to the public health and safety—unless the Commission further finds that there are "compelling reasons" for such location.

2. Whether the Act requires the Commission, in granting a permit for the construction of a developmental atomic power reactor, to make the same findings with respect to the safety of its operation as are required before it grants an operating license.[3]

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[2] "Tr." refers to the original pagination of the certified transcript which is indicated in bold face in the printed Joint Appendix in the court of appeals. Nine copies of the Joint Appendix and one copy of the entire certified transcript have been filed in this Court accompanying the petition in No. 315.

[3] A subsidiary question presented—which we intend to argue if certiorari is granted—is whether, as the court of appeals held (App. *infra*, p. 43), "the Commission's findings regarding safety of operation are ambiguous." See note 16, *infra*, p. 20.

3. Whether respondent unions were persons aggrieved by the grant of a construction permit, where the alleged injury would result from the operation, and not from the construction, of the reactor, and where a further Commission order was required before the reactor could be operated.

STATUTE AND REGULATIONS INVOLVED

The pertinent provisions of the Atomic Energy Act of 1954, the Judicial Review Act of 1950, and the Commission's regulations are set forth in the Appendix *infra*, pp. 49–62.

STATEMENT

This case involves the validity of a permit for the construction of a large developmental atomic power reactor, issued by the Atomic Energy Commission under the Atomic Energy Act of 1954, in accordance with its regulations. A divided court of appeals set aside the permit, on the ground that the Commission's findings did not satisfy the statutory requirements for the granting of such permits.

Section 104 of the Act (42 U.S.C. 2134, *infra*, pp. 50–52) authorizes the Commission to license reactors for various purposes, including "research and development activities leading to the demonstration of the practical value of such facilities for industrial or commercial purposes." Section 185 of the Act (42 U.S.C. 2235, *infra*, p. 55) provides that reactors shall be constructed pursuant to construction permits and that, upon the completion of construction and if certain specified conditions are met, an operating license will be issued. The Commission has promulgated detailed

regulations governing the issuance of both construction permits and licenses (see 10 CFR, Part 50).

I. The administrative proceedings

On January 6, 1956, Power Reactor Development Company ("PRDC")[4] submitted an application for a "license to design, construct, and operate a developmental fast neutron breeder reactor" at Lagoona Beach, Michigan, about 30 miles southwest of Detroit (Tr. 5116–5127). A power reactor is a complex plant which produces electricity by harnessing the thermal energy of atomic fuel in a controlled nuclear fission chain reaction, in the same way that conventional generating facilities utilize the energy released when coal or other fuels are burned. The fact that the nuclear fission in a power reactor is controlled distinguishes such reactor from the atomic bomb, which involves an *uncontrolled* very rapid chain reaction, in which tremendous quantities of energy are released in a few millionths of a second. Because of this basic difference, "it is impossible that the reactor could ever explode like an atomic bomb" (Tr. 3960, 3974–3975; see note 14, *infra*, p. 17). There has been a "perfect record of safety of the regularly operating reactors" (Tr. 4854).

The "fast breeder" reactor proposed by PRDC is one of the types described to Congress, during the hearings on the Atomic Energy Act of 1954, as a pos-

[4] PRDC is a non-profit membership corporation composed of utility and industrial companies (Tr. 3922, 6990), organized in 1955 "to study, develop, design, fabricate, construct and operate one or more experimental nuclear power reactors * * * to the end that there may be an early demonstration of the practical and economical use of nuclear energy for the generation of electric energy * * *" (Tr. 5137–5138).

sible method for economic production of electricity from atomic power.[5] The special characteristic of such a reactor is that, while producing power (from the heat of nuclear fission in the reactor core), it will also produce more fissionable material usable as a reactor fuel (by the capture of neutrons in a blanket of nonfissionable material surrounding the core) than it consumes (Tr. 6972–6975). Since the success of a fast breeder reactor will increase the nuclear fuel available from natural sources more than a hundred times, it is one of the most "promising" approaches to feasible atomic power at the present time and its success seems "indispensable" to the future development of the widespread use of such power. See Tr. 3958–3959, 4083–4085, 4124–4128, 7021.

As authorized by Section 189 of the Act as it then stood (68 Stat. 955) and its regulations (10 CFR 2.102), the Commission issued a provisional permit to PRDC without a hearing,[6] subject to the right of

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[5] See Hearings on S. 3323 and H.R. 8862 before the Joint Committee on Atomic Energy, 83d Cong., 2d Sess., pp. 493–494, 565, 568, 2 Legislative History of the Atomic Energy Act of 1954 (hereinafter cited as "Leg. Hist.") 2127–2128, 2203, 2206; 100 Cong. Rec. 10432–10433, 3 Leg. Hist. 3253–3254. If licensed to operate, the PRDC plant would be the first privately owned large-scale fast breeder power reactor in this country. A Commission-owned experimental breeder reactor was successfully used for the production of electric energy in 1951 (S. Rep. 1699, 83d Cong., 2d Sess., p. 3; 1 Leg. Hist. 751).

[6] Section 189 was amended in 1957 to provide for mandatory hearings upon applications for power and testing reactor licenses and construction permits (71 Stat. 579; S. Rep. 296, 85th Cong., 1st Sess., pp. 24–25; H. Rep. 435, 85th Cong., 1st Sess., pp. 24–25).

any interested party to request it.[7] Petitions for intervention and for a hearing were filed by respondent unions and certain union officers (Tr. 6298–6336).[8] The Commission granted intervention and set the matter for hearing (Tr. 6359). A lengthy hearing was held, and the record was then certified to the Commission. After hearing oral argument, the Commission issued an opinion and initial decision affirming and continuing in effect the construction permit, with amendments (Tr. 6846–6894). Following the filing of exceptions and further briefs, the Commission issued an opinion and final decision (Tr. 6933–7033), which "amplif[ied] and affirm[ed]" its initial decision (Tr. 6934).

II. The Commission decision

The Commission rejected the unions' contention that "the same findings, with respect to safety * * * for issuance of an operating license are necessary for

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[7] The permit made various findings and declared that conversion to an operating license was subject to submission of a final Hazards Summary Report showing that the health and safety of the public would not be endangered by operation of the reactor. The permit stated that upon such a submission, the completion of the reactor in accordance with the permit, the filing of additional information, a finding of compliance with the Act and regulations, and in the absence of any good cause being shown why the granting of a license would not be in accordance with the Act, the Commission would issue a license for 25 years (Tr. 6294–6295).

[8] The petitions asserted that the permit "will result in the construction of a reactor which, under present technological conditions, is inherently unsafe," and which would "imperil and destroy" lives, properties and places of employment, and adversely affect real estate and other property values and property rights (Tr. 6301–6302, 6316, 6326–6327).

issuance of a provisional construction permit" (Tr. 6939), and that no construction permit could be issued "unless there is sufficient foundation in the record now for the issuance of a license to operate" (Tr. 6952). The Commission pointed out (Tr. 6946–6947) that Section 185 of the Act distinguishes between construction permits and licenses, and that "under the statute, a construction permit is a step toward a license rather than the equivalent thereof" (Tr. 6950). It held (Tr. 6953–6954) that the Act, the legislative history, the state of development of the industry, and the Commission's own regulations fully justified the distinction between the grounds required for issuance of a construction permit and an operating license.

The Commission stated that, at the present developmental stage of atomic power reactors, the only practical approach is that provided by Section 50.35 of its regulations (10 CFR 50.35, *infra*, pp. 61–62), namely, to issue a provisional construction permit based on findings of a reasonable assurance that a reactor of the general type can be safely constructed and operated at the proposed site and that safety problems can be resolved; and to require continuing research and study which will establish, before operation is authorized, that the reactor in its final design can be operated without undue risk to public health and safety (Tr. 6957–6964, 6977–6978, 6980, 6983–6984). The Commission, in the precise terms required by its regulation, found reasonable assurance that a reactor of the general type proposed by PRDC can be constructed and operated at the proposed site without

undue risk to the public health and safety, and that technical information required to complete the PRDC application—and thus definitely establish safety of operations—will be supplied (Tr. 6971, 6983–6986, 7015–7020, 7022–7023). It found that there were no inherent hazards or insoluble problems in the construction or operation of fast breeder reactors (Tr. 6983, 7015), and that there was reasonable assurance that further research would demonstrate that the PRDC reactor (with design modifications, if necessary) can be operated at Lagoona Beach, Michigan, without undue risk to the public health and safety (Tr. 6971, 6984–6985, 7019–7020, 7022–7023). The Commission rejected the unions' contention that "the heavy investment in the reactor always will generate irresistible pressure for its operation so as to protect the investment itself," and that "construction of the reactor inevitably means its operation in this case" (Tr. 6954).

The amended construction permit set forth its provisional character and listed the various findings (including those on safety) which will be required before an operating license will be issued (Tr. 7030–7031). The amended permit stated that it did not constitute final approval of any technical specification, which approval would be required before an operating license is issued (Tr. 7028). Finally, the Commission expressly reserved jurisdiction to reopen the proceeding for further evidence and for consideration of data pertinent to safety, at any time prior to the issuance of an operating license (Tr. 7026, 7031). The Commission stressed that it will not

issue an operating license unless, after another full hearing, it is satisfied that operation will satisfy the Act's safety criteria (Tr. 6938, 6956, 6983, 6987, 7024, 7028, 7030–7031). It emphasized (Tr. 6952) that "public safety is the first, last and a permanent consideration in any decision on the issuance of a construction permit or a license to operate a nuclear facility."

III. The decision of the court of appeals

A majority of the court of appeals set aside the Commission's grant of the construction permit. The court ruled that the respondent unions had standing to maintain the action, and that the Commission's grant of the permit was invalid because (1) the Act requires the agency, when it grants a construction permit, to make the same findings of safety of operations that it must make before granting an operating license; (2) that the Commission's safety findings were ambiguous because they failed to state "a positive opinion regarding safety of operations"; and (3) that such findings are deficient "in an additional respect," namely, that the Commission did not make the further finding, which the court construed the Act to require, that there were "compelling reasons" for locating the reactor near a heavily populated area "where it will expose so large a population to the possibility of a nuclear disaster" (App. *infra*, pp. 32–45).

In his dissent, Judge Burger concluded that the court should not have reached the merits of ultimate safety of operation of the PRDC plant. He pointed

out that this issue had been deferred by the Commission until after further administrative steps designed to assure safety, and he disagreed with the majority's view that a "*future possibility* that an operating permit will be unlawful and improperly issued by the Commission creates a 'present,' 'immediate' and 'unavoidable threat' of injury." (App. *infra*, pp. 45–46). In addition, Judge Burger stated that a "step by step" review and approval of reactor design was a necessity in the present developmental state of nuclear technology and that the majority's reversal of this procedure went "beyond the established limits of judicial review." He further stated that the majority, in its ruling on reactor location, was "undertaking to assume responsibilities which Congress vested in the Commission" when it made "a finding of 'nuclear disaster' directly opposed to the finding which the Atomic Energy Commission made." (App. *infra*, pp. 46–49).

Petitions for rehearing *en banc* were filed by the Government and PRDC, and were denied (Judges Miller and Bastian dissenting, and Judges Washington and Burger not participating) (App. *infra*, pp. 66–67).

REASONS FOR GRANTING THE WRIT

This is a case of major national importance to the administration and implementation of this country's long-range program for the development of the peaceful uses of atomic energy. In the first judicial interpretation of the licensing provisions of the Atomic Energy Act of 1954, a sharply-divided court of appeals has set aside the Atomic Energy Com-

mission's grant of a permit for the construction of a developmental atomic reactor for the production of electric power. The two principal grounds of that decision—that the Commission cannot locate such a reactor near a heavily populated area unless it finds "compelling reasons" therefor, and that, in approving the construction of the reactor, the Commission must make the same findings as to the safety of its ultimate operation as it would have to make before it could license such operation—would seriously impede and, in significant areas, might even block, the programs and policies that the Atomic Energy Commission has carefully developed in this important area of national scientific achievement.

To date, the Atomic Energy Commission has licensed the construction of nine developmental power reactors (including the instant one). In each case, the site of the proposed reactor has been approved by the Commission after full consideration of the pertinent statutory criteria for safety of operation, but without making any finding of "compelling reasons" in the several cases in which the reactor site is located a comparable distance from a populated area.[9] Similarly, in each case the Commission, in accordance with a long-standing regulation (10 CFR 50.35), granted a construction permit on the same terms as here involved, namely, construction was authorized upon

[9] A listing of power reactors now operating or being constructed, and distances from nearby population centers, is set out in the Appendix *infra*, pp. 62–64. There are also numerous small research reactors operated by universities and other institutions in metropolitan areas.

findings of reasonable assurance that a reactor of the general type proposed can be constructed and operated at the proposed site without undue risk to the public health and safety and that information required to complete the application—and thereby establish the safety of the particular reactor's final design—will be supplied. The authorization was subject to further proceedings, upon completion of construction, in which safety of operation would have to be established before an operating license would issue.

The decision below, which without referring to Regulation 50.35 implicitly invalidated it, necessarily raises serious question as to the validity of the construction of these eight other power reactors. Moreover, it will inevitably have a seriously discouraging effect on the development of future atomic power projects. Finally, the PRDC reactor is itself an important factor in the national program to develop practical atomic power, and its validity, therefore, itself presents an important question. In view of the clear importance of these issues to the national welfare, and since, as we now show, the decision below is erroneous in several important respects, review by this Court is plainly called for.

I

The basic scheme of the Atomic Energy Act of 1954 is to establish general conditions for the protection of public health and safety, but to leave to the Commission the implementation thereof through its rule-making authority. Thus, Section 3(d) lists as one of the Act's purposes the provision of a "program to en-

courage widespread participation in the development and utilization of atomic energy for peaceful purposes to the maximum extent consistent * * * with the health and safety of the public." Section 182 provides that an applicant for a reactor operating license shall submit such information as "the Commission may, by rule or regulation, deem necessary in order to enable it to find that the utilization or production of special nuclear material * * * will provide adequate protection to the health and safety of the public." See, also, Section 103(b). Similarly, Section 104(b), which governs the licensing of developmental power reactors such as that of PRDC, directs the Commission to "impose the minimum amount of such regulations and terms of license as will permit the Commission to fulfill its obligations * * * to protect the health and safety of the public * * *." Finally, Section 161(b) authorizes the Commission to "establish by rule, regulation, or order, such standards and instructions to govern the possession and use of special nuclear material, source material, and byproduct material as the Commission may deem necessary or desirable * * * to protect health or to minimize danger to life or property," and Section 161(i) authorizes it to "prescribe such regulations or orders as it may deem necessary * * * (3) to govern any activity authorized pursuant to this Act, including standards and restrictions governing the design, location, and operation of facilities used in the conduct of such activity, in order to protect health and to minimize danger to life or property."

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Pursuant to this legislative design, the Commission has promulgated numerous regulations designed to insure that all phases of atomic power development and use, including the construction and operation of nuclear reactors, will fully "protect health and * * * minimize danger to life or property" (Section 161(i)(3), *supra*) and be "consistent * * * with the health and safety of the public" (Section 3(d), *supra*). Of course, as the Commission here pointed out (Tr. 6984), the site of the reactor is an essential consideration in determining the safety of the proposed project, and on occasion unfavorable site characteristics have required relocation or abandonment of projects.[10] However, in determining the ultimate overall safety of the project, the Commission considers location along with other pertinent factors. These include the reactor type (the range of neutron energies, enrichment of fuel, structural materials, coolant and moderator), the reactor power level, the pressure and temperature at which the reactor will be operated, the control and safety devices, the shielding and the containment. Here, on the basis of all these factors, including the site, the Commission found that the safety standards were met.

We submit that this treatment of the problem by the Commission—safety determination based upon all the significant considerations involved—fully satisfies the safety standards of the Act, and that there is no basis for the court of appeals' engrafting on to the Act the additional standard that no reactor can be

[10] See, *e.g.*, *City of Piqua, Ohio*, A.E.C. Docket No. PP-2; Point LOMA Process Heat Reactor, Report of Advisory Committee on Reactor Safeguards, March 14, 1960.

located close to "so large a population" unless there are "compelling reasons" for doing so (App. *infra*, p. 44). There is no such language or concept in the Act, and the court below offered no explanation of what this phrase means or what standards are to be used in applying it.

(a) The legislative history shows that Congress recognized that the protection of public health and safety was one of the areas of "special competence" and "responsibility" of the Commission (100 Cong. Rec. 10079, 3 Leg. Hist. 3103), and that Congress believed that, by giving the Commission broad discretion in this field, "greater private participation in power development need not bring with it attendant hazards to the health and safety of the American people." S. Rep. 1699, 83d Cong., 2d Sess., p. 3, 1 Leg. Hist. 751; H. Rep. 2181, 83d Cong., 2d Sess., p. 3, 1 Leg. Hist. 999. The legislative history further shows that Congress contemplated that the safety regulation it was committing to the Commission's discretion included supervision of the location of reactors.[11]

Moreover, the legislative history indicates that Congress understood that many power reactors (like conventional utility facilities) would be constructed and operated near the power-consuming "metropolitan and industrial centers."[12] Such locations were implicit in the President's prediction of an industry to be "as nearly normal as possible," while regulated for

[11] Hearings on S. 3323 and H.R. 8862 before the Joint Committee on Atomic Energy, 83d Congress, 2d Sess., p. 118, 2 Leg. Hist. 1752.

[12] Hearings, *supra*, p. 582, 2 Leg. Hist. 2220.

security and safety (H. Doc. 328, 83d Cong., 2d Sess., pp. 6–7, 1 Leg. Hist. 50–51), and in the clear legislative intent to chart a course for atomic power reactors as "an integral part of the electric-generating activities of the country." (Fn. 12, *supra*.) Indeed, one of the basic purposes of the Atomic Energy Act of 1954 was to foster progress in atomic power development by encouraging the widespread participation of private industrial and utility companies and publicly-owned utilities.[13] Effective participation by utilities, however, may be impossible if, as the decision below suggests, large power reactors cannot be located near the utilities' urban service areas. It would not be feasible to locate reactors designed to serve urban areas in remote parts of the country.

Congress anticipated that reactors might be located close to metropolitan centers during the initial developmental stage of atomic power. As an example of such development, there were repeated references to the Shippingport Pressurized Water Reactor, then being constructed about 30 miles from the center of Pittsburgh—"the Nation's first large-scale atomic-power reactor, which will generate 60,000 kilowatts of electricity—an amount sufficient to furnish light and power for a sizable city." S. Rep. 1699, 83d Cong., 2d Sess., p. 3, 1 Leg. Hist. 751; H. Rep. 2181, 83d Cong., 2d Sess., p. 3, 1 Leg. Hist. 999. And Senator Kennedy testified in favor of the location

[13] See Sections 1(b), 3 (a), (d), 182 (c), (d), 42 U.S.C. 2011, 2013 (a), (d), 2232 (c), (d). H. Doc. 328, 83d Cong., 2d Sess., pp. 6–7, 1 Leg. Hist. 50–51; S. Rep. 1699, 83d Cong., 2d Sess., pp. 3, 9, 1 Leg. Hist. 751, 757; H. Rep. 2181, 83d Cong., 2d Sess., pp. 3, 9, 1 Leg. Hist. 999, 1005.

of "pilot plant activity" and "experimental plants" in New England, where eventual commercial feasibility could be anticipated. Hearings, *supra,* pp. 774–780, 2 Leg. Hist. 2412–2418. See, also, as to New York State, 100 Cong. Rec. 10910, 3 Leg. Hist. 3461.

In the light of the broad discretion given to the Commission to deal with safety, including the location of reactor sites, and the recognition by Congress that reactors would be located near metropolitan areas, we submit that, had Congress intended to impose the condition that reactors could be located near populated areas only upon a showing of "compelling reasons," it would have said so in clear and specific terms. Nothing in the "Congressional concern for safety," to which the court below referred, justifies the court's conclusion that "Congress intended no reactor should," without such reasons, be located near a populated area (App. *infra,* p. 44).

(b) There is no basis in this record for the court's finding (*ibid.*) that the location of the PRDC reactor approximately 30 miles from Detroit will "expose" a large "population to the possibility of a nuclear disaster."[14] The Commission's findings, the eviden-

[14] The court below may have been under a misapprehension of what hazards are presented by the operation of a power reactor. In a reactor, heat is generated by a *controlled* fission chain reaction. As an eminent scientist, Dr. Hans Bethe, testified, an accident in a reactor would be "at the worst, comparable to a boiler explosion" and "it is * * * impossible that the reactor ever explode like an atomic bomb. There is no way in which this could ever happen. The hazards we are speaking of in nuclear reactors do not lie in any violent explosion, but in the possibility that the radioactive fission products which have been formed by the operation of the reactor get

tiary basis of which was neither challenged on review nor overturned by the court, are to the contrary (see *supra*, pp. 7–8). The two items on which the court relied for its conclusion were general statements about hypothetical incidents in hypothetical plants made in 1956 and 1957 to support the need for indemnity insurance and design precautions.[15] In no way do they undermine or invalidate the Commission's findings that there was reasonable assurance that a reactor of this general type could be operated at this site "without undue risk to the public health and safety" and that the PRDC reactor's final design will be shown to be safe (see pp. 7–9, *supra*).

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released into the atmosphere and thereby cause a radiation hazard for the surrounding area." Tr. 3960, 3974–3975. Dr. Bethe further explained that protection against such "extremely remote possibilities" (Tr. 3961) is provided by various inherent features of reactors, safety devices, and shielding and containment (Tr. 3960–3979).

[15] The first item cited, a 1957 report of the Commission (App. *infra*, p. 43–44), was an appraisal of the extreme consequences of hypothetical incidents, prepared as a background for legislative action to provide Government indemnity to licensees, now Section 170 of the Act, 42 U.S.C. 2210. It did not probe the possibility or probability of the occurrence of nuclear incidents. The alleged "[u]ndisputed testimony before the Commission" (App. *infra*, p. 44) was a quotation from the testimony at the 1956 Congressional hearings on the indemnity legislation by Dr. C. Rogers McCullough, former Chairman of the Commission's Advisory Committee on Reactor Safeguards, read into the record of this case at Tr. 3001. In 1956, Dr. McCullough referred to the "possibility" of widespread injury as the ground for taking unusual precautions in reactor design, maintenance and operation to prevent any incident, as had been successfully done. Hearings on Governmental Indemnity before the Joint Committee on Atomic Energy, 84th Cong., 2d Sess., pp. 47–50.

(c) Respondent unions presumably will urge, as they did in opposing rehearing *en banc* below, that the court's holding of "compelling reasons" does not have the broad reach that we ascribe to it. On the face of the opinion, however, the court not only purported to, but in fact did, lay down the general rule, "that Congress intended no reactor should, without compelling reasons," be located close to a populated area. This statement was not merely dictum, since it was one of two expressed grounds upon which the court set aside the Commission's "findings regarding safety of operations" as "not sufficient" and "deficient" (App. *infra*, pp. 39, 43, 45).

II

This case presents a second question crucial to the reactor licensing program—the validity of the standards of operating and construction safety employed by the Commission in authorizing construction of developmental reactors. Construction permits for each of the nine licensed developmental power reactors and most of the research and testing reactors have been issued "on a provisional basis" pursuant to Section 50.35 of the Commission's regulations (*infra*, pp. 61–62). This regulation authorizes issuance of a construction permit on the basis of "information sufficient to provide reasonable assurance that a facility of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public and that the omitted information will be supplied." Conversion of this permit to an operating license is contingent upon later production of the omitted information "and

an evaluation by the Commission that the final design provides reasonable assurance that the health and safety of the public will not be endangered." See the Commission's opinion, *supra*, pp. 7–8.

The use of such construction permits was, in effect, invalidated when the court below held, without citing Section 50.35 of the regulations, that the Commission "must" make the same findings on the safety of reactor design and operation "when it authorizes construction" as "when it authorizes operation" (App. *infra*, p. 36). While Section 50.35 requires only a finding as to the safety of the "general type" of facility proposed, the court of appeals decision would require the Commission, before it can authorize the construction of a reactor, to make a definitive finding as to the safety of the ultimate operation of the particular "reactor * * * proposed by Applicant" (App. *infra*, pp. 36, 41). In the present state of scientific development, however, the Commission frequently cannot make a final determination as to operating safety of a reactor design prior to completion of construction. We submit that the Act does not require the Commission to do so, and that its present two-stage authorization fully satisfies the statutory requirements.[16]

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[16] A subsidiary question is presented by the holding of the court below—which we think erroneous—that the Commission's findings on safety of operation were "ambiguous." The court contrasted what it believed to be the Commission's "repeated expressions of uncertainty" and "positive opinion regarding safety of operation" (App. *infra*, pp. 41–43). The court did not refer to Section 50.35 of the Commission's regulations which specifically provides for the two types of findings made here—a present finding on the general type of reactor (the "positive opinion") and a tentative conclusion as the eventual demonstra-

(a) Provisional construction permits are now necessary since, in the present developmental stage of atomic energy, all large-scale power reactors (and most others) are substantially unique in design. The result is that, in the language of Regulation 50.35, "an applicant is not in a position to supply initially all of the technical information otherwise required to complete the application." By permitting construction to proceed simultaneously with the completion of research and development, the procedure of Section 50.35 saves several years on each project, as was found here (Tr. 7022). Furthermore, the process of testing and verifying design and operating techniques during construction, involving "a sort of combined construction and research and development and necessary dovetailing of these things", is basic to technological advances and assures improved design for ultimate safety of operation (Tr. 3278, 6983). As Judge Burger pointed out in his dissent (App. *infra*, pp. 46, 48), progress in this area must, necessarily, be "step by step." A rigid requirement of prior design approval, however, would seriously delay each new major developmental project; would discourage reactors incorporating "major advances" (like PRDC's, Tr. 7015–7016), which are given priority under Section 104(b); and would lead to duplication of existing designs—all contrary to the Congressional purpose and the scientific and administrative realities of attaining

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tion of the safety of a final design in the light of the applicant's research and development program (the alleged "expressions of uncertainty"). If certiorari is granted, we shall argue that the findings are not ambiguous.

practical atomic power that is competitive with power obtained from other sources.

The Commission's practice fully satisfies the Act's safety requirements. Under that practice, safety is assured by the initial determinations made under 10 CFR 50.35, followed by the later stringent scrutiny of the final design prior to actual licensing of operations. At both stages, a public hearing is held. Ultimate safety of operations would not be increased by requiring the Commission to make a definitive safety determination before it issues a construction permit. For in the swift-moving technology of atomic reactors, the Commission can best determine the design safety of new facilities by continuous examination throughout the construction period, with final approval or disapproval withheld until completion of construction. The Commission thus permits the safety of a particular reactor to be determined on the basis of all scientific developments that occur up to the final decision on licensing of operation, and will not license operation unless and until safety standards are satisfied.

(b) The validity of the Commission's practice, and the regulation upon which it is based, is, we submit, fully sustained by both the language of the Act and its legislative history and purpose. They show (1) that Congress did not impose any requirement that ultimate operating safety be definitely determined when a construction permit is granted, but left it to the Commission to work out, through appropriate regulations, the best method for implementing the basic statutory requirement (Sections 104(b), 182(a)) that there be "adequate protection to the health and safety

of the public" before operation is authorized; and (2) that it was understood, when the Act was passed in 1954, that the grant of a construction permit would not insure the subsequent grant of an operating license, and that the Commission would not authorize operation unless it then found that the safety requirements were met.

Section 185 of the Act (*infra*, p. 55) provides for both construction permits and operating licenses. No standards are prescribed for the former; the Commission is directed to issue a construction permit "if the application is otherwise acceptable to the Commission." In the case of operating licenses, however, standards are prescribed. An operating license is to be issued only (1) "[u]pon the completion of the construction * * * of the facility," (2) "upon the filing of any additional information needed to bring the original application up to date," (3) "upon finding that the facility authorized has been constructed and will operate in conformity with" the amended application and appropriate statutory provisions and regulations, and (4) "in the absence of any good cause being shown to the Commission why the granting of a license would not be in accordance with the provisions of this Act."

These provisions—particularly the requirements of "good cause" and future operation "in conformity with" law—were designed to assure that the statutory criteria for ultimate safe operation were met before operation is authorized, and to give the Commission discretion in formulating appropriate safety standards for the construction permit stage of licens-

ing. They cannot fairly be read as requiring the Commission to make the same findings "regarding safety of operation" (App. *infra*, pp. 36, 39) in order to grant a construction permit as the agency is required to make in granting a final operating license. This conclusion is further supported by Section 182(a) (*infra*, p. 53, emphasis added), which provides that applicants for "licenses to *operate* production or utilization facilities" shall submit such "technical specifications" and "other information" as the Commission may require in order to find that the proposed operation "will provide adequate protection to the health and safety of the public." Had Congress intended the same standards also to be applicable under Section 185 to the grant of construction permits—which explicitly provide authority "to construct or modify" (but not to operate)—it would have said so.

The Act was so understood at the time of its passage. It was recognized that Section 185 represented a deliberate departure from the scheme of the Communications Act of 1934, under which all definitive decisions with respect to the application before it are made when the agency issues a construction permit.[17] Certain industry spokesmen pro-

[17] Compare the "good cause" provision of Section 185 with Section 319(c) of the Communications Act, 47 U.S.C. 319(c), which requires issuance of an operating license to the holder of a construction permit unless a "cause or circumstance arising or first coming to the knowledge of the Commission since the granting of the permit would * * * make the operation of such station against the public interest." The Communications Act was clearly the point of departure for the drafting of Section 185. See Hearings on S. 3323 and H.R. 8862 before the Joint Committee on Atomic Energy, 83d

tested the "good cause" provision of Section 185 and vainly sought its deletion, urging that all "fundamental" determinations should precede construction, and that issuance of a license should be assured when construction is completed. Hearings on S. 3323 and H.R. 8862 before the Joint Committee on Atomic Energy, 83d Cong., 2d Sess., pp. 113, 117–119, 226–227, 417, 2 Leg. Hist. 1747, 1751–1753, 1860–1861, 2051. Congress, however, rejected this proposal, and instead left it to the Commission to select an appropriate method for implementing the statutory directive (Section 104(b), *infra*, pp. 50–51) that in licensing the operation of developmental reactors the Commission shall "fulfill its obligations under this Act * * * to protect the health and safety of the public * * *." The provisional construction permit system, provided by Section 50.35 of the regulations under which final operating authority is not granted unless and until operating safety is established, is a valid implementation of the Congressional design.

Moreover, the Commission repeatedly has informed Congress of its use of provisional construction permits and the compelling reasons therefor, beginning before promulgation of 10 CFR 50.35 in 1956.[18] In

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Cong., 2d Sess., pp. 117–118, 2 Leg. Hist. 1751–1752; Marks & Trowbridge, *Framework for Atomic Industry*, p. 76 (1955); Green, *The Law of Reactor Safety*, 12 Vanderbilt L. Rev. 115, 122.

[18] Hearings on Development, Growth, and State of the Atomic Energy Industry before the Joint Committee on Atomic Energy, 84th Cong., 2d Sess., pp. 106, 133, Tr. 6959, 6961; Hearings on Governmental Indemnity before the Joint Committee on Atomic Energy, 84th Cong., 2d Sess., pp. 62–65; Hearings on Development, Growth, and State of

view of the "subsequent and continuing action by the Congress" in the atomic energy field, and particularly, the close relation prescribed by Section 202 of the Act between the Commission and the Joint Committee on Atomic Energy, "[s]uch a record constitutes ratification of administrative construction." *Ivanhoe Irrigation District* v. *McCracken*, 357 U.S. 275, 292–294; *Panama Canal Co.* v. *Grace Line, Inc.*, 356 U.S. 309, 318–319; *Brooks* v. *Dewar*, 313 U.S. 354, 361.

(c) The court of appeals held (App. *infra*, p. 39), however, that two items of legislative history made it "doubtful" whether the Commission's construction of the Act is valid, and then resolved that doubt against the Commission because the "possibilities of harm are so enormous." Apart from the fact that this approach to statutory construction disregards the settled principle that an agency's interpretation of its own Act is entitled to great weight, we submit that neither of these two items raises any substantial doubt as to the correctness of the Commission's construction.

The principal item relied upon was a colloquy between Senators Humphrey and Hickenlooper, during which Senator Humphrey withdrew a proposed

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the Atomic Energy Industry before the Joint Committee on Atomic Energy, 85th Cong., 2d Sess., pp. 119–121, 123, Tr. 6962–6964; Hearings on Operation of AEC Indemnity Act before the Joint Committee on Atomic Energy, 85th Cong., 2d Sess., pp. 56–57. See also *A Study of AEC Procedures and Organization in the Licensing of Reactor Facilities*, Joint Committee on Atomic Energy, 85th Cong., 1st Sess. (Joint Committee Print, 1957).

amendment to Section 185 which would have required that "no construction permit shall be issued by the Commission until after the completion of the procedures established by Section 182 for the consideration of applications for licenses under this act." He did so upon being assured by Senator Hickenlooper that "the revised sections on judicial review and on hearings and the revised section 182 on license application all apply directly to construction permits." App. *infra*, pp. 37–38. However, the context of this discussion, like the remainder of the debate in Congress over these sections, shows that it had nothing to do with the safety provisions of Section 182(a). It related to the provisions in Sections 182 (c) and (d) and 189, which require that notice of hearing on applications for construction permits be given to municipalities, public bodies and cooperatives, give these groups the right to judicial review in such proceedings, and guarantee them certain preferences in licensing. See, *e.g.*, 100 Cong. Rec. 11566, 10397, 10398, 11754, 3 Leg. Hist. 3759, 2848, 2849, 3877; S. Rept. 1699, 83d Cong., 2d Sess., pp. 121–123, 1 Leg. Hist. 869–871; H. Rept. 2181, 83d Cong., 2d Sess., pp. 121–123, 1 Leg. Hist. 1117–1119.

The court also relied (App. *infra*, p. 39) on the statement in the Joint Atomic Energy Committee report on the bill that Section 185 "requires the issuance of a license if the construction is carried out in accordance with the terms of the construction permit." But, as we have shown (*supra*, pp. 23–24), this is only one of the conditions in Section 185 for the granting of an operating license, and other conditions

therein clearly require the Commission to make the necessary safety findings at that time. Moreover, one of the terms of every construction permit for a reactor, including this one, is that before an operating license is granted the Commission must find that operation will not endanger "the health and safety of the public" (Tr. 7030).

III

A third significant error committed by the court below was its preliminary ruling (App. *infra*, pp. 33–35) that respondent unions were "aggrieved" by the issuance of the construction permit, and therefore had standing under 5 U.S.C. 1032 to challenge it. This ruling, we believe, conflicts with settled principles governing standing to review administrative orders.

The court below pointed out (App. *infra*, p. 34) that the unions' claim to standing was not that construction itself would cause injury, but that "construction would cause operation, and operation would cause injury." It held this claim sufficient to establish standing, on the theory that "it is plainly probable, in a high degree, that if the construction permit stands PRDC will get an operating license and will operate" (App. *infra*, p. 35). However, there is a crucial gap in this reasoning.

The court of appeals made no finding, nor could it, that there was any probability that the Commission would issue a license to operate under hazardous conditions. On the contrary, the record is clear and uncontradicted that no operating license can or will be

issued until after the completion of further administrative proceedings devoted to a stringent scrutiny of the final PRDC design, necessarily developed in part during the construction phase of the project. See *supra*, pp. 8–9. Petitioners can participate fully as intervenors in such future proceeding, and will be able to seek review of any future order authorizing an operation which they challenge as hazardous. As Judge Burger declared in dissent, petitioners have established only a "future possibility" of aggrievement in the unlikely event that an operating license "will be unlawfully and improperly issued," contrary to the Commission's statements (App. *infra*, p. 46).

On this point, the decision below is inconsistent with the decisions of this Court that administrative determinations are reviewable only when the alleged impact is "immediately pressing," not "remote or speculative," or contingent upon future agency action. *Eccles* v. *Peoples Bank*, 333 U.S. 426, 431–435; *Public Service Commission* v. *Wycoff Co.*, 344 U.S. 237, 242–246; *Chicago & Southern Air Lines* v. *Waterman Steamship Corp.*, 333 U.S. 103, 112–113.

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CONCLUSION

For the foregoing reasons, this petition for a writ of certiorari should be granted.

Respectfully submitted.

J. LEE RANKIN,
Solicitor General.
GEORGE COCHRAN DOUB,
Assistant Attorney General.
MORTON HOLLANDER,
Attorney.

NEIL D. NAIDEN,
Acting General Counsel,
COURTS OULAHAN,
Deputy General Counsel,
LIONEL KESTENBAUM,
Attorney, Atomic Energy Commission.

SEPTEMBER 1960.

APPENDIX

UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

No. 15271

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL–CIO; UNITED AUTOMOBILE, AIRCRAFT AND AGRICULTURAL IMPLEMENT WORKERS OF AMERICA; AND UNITED PAPERMAKERS AND PAPERWORKERS, PETITIONERS

v.

UNITED STATES OF AMERICA AND ATOMIC ENERGY COMMISSION, RESPONDENTS

POWER REACTOR DEVELOPMENT COMPANY, STATE OF MICHIGAN, INTERVENORS

On Petition to Review an Order of the Atomic Energy Commission

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Decided June 10, 1960

Mr. Benjamin C. Sigal for petitioners.

Mr. Lionel Kestenbaum, Attorney, Atomic Energy Commission, with whom *Assistant Attorney General Doub, Messrs. Loren K. Olson,* General Counsel, Atomic Energy Commission, *Charts Oulahan,* Special Assistant to the General Counsel, Atomic Energy Commission, and *Samuel D. Slade,* Attorney, Department of Justice, were on the brief, for respondents.

Mr. W. Graham Claytor, Jr., with whom *Mr. John Lord O'Brian* was on the brief, for intervenor Power Reactor Development Company.

Mr. Jerome Maslowski entered an appearance for intervenor State of Michigan.

Before EDGERTON, BAZELON, and BURGER, *Circuit Judges.*

EDGERTON, *Circuit Judge:* Petitioners seek review of the Atomic Energy Commission's Order of May 26, 1959 which continued in effect, with amendments, a "provisional" construction permit issued August 4, 1956, for a nuclear power reactor. Section 104b of the Atomic Energy Act of 1954 authorizes the Commission to issue licenses for "utilization and production facilities involved in the conduct of research and development activities leading to the demonstration of the practical value of such facilities for industrial or commercial purposes. In issuing licenses under this subsection, the Commission shall impose the minimum amount of such regulations and terms of license as will permit the Commission to fulfill its obligations under this Act to promote the common defense and security and to protect the health and safety of the public * * *." 68 Stat. 937, 42 U.S.C. § 2134(b).

The holder of the construction permit, intervenor here, is the Power Reactor Development Company (PRDC), a Michigan membership corporation organized "to study, develop, design, fabricate, construct and operate one or more experimental nuclear power reactors * * * to the end that there may be an early demonstration of the practical and economical use of nuclear energy for the generation of electrical energy * * *." Of PRDC's 21 members, 14 are public utilities and 7 are equipment manufacturers.

The reactor will be the largest, but not the first, "fast breeder" reactor in the United States. The site

is at Lagoona Beach, Monroe County, Michigan, on the shore of Lake Erie, 30 miles southwest of Detroit.

PETITIONERS' STANDING

We cannot review the Commission's order at petitioners' request unless (1) it is a "final order" and (2) petitioners are "aggrieved" by it. Atomic Energy Act of 1954, § 189, 42 U.S.C. § 2239(b); 5 U.S.C. §§ 1032, 1034. Although the Commission's action of May 26, 1959 was entitled "Commission's Opinion, Final Decision and Order," the Commission and PRDC now contend that the order was not final. They also contend that it did not aggrieve the petitioners. In our opinion it was what it purported to be, a final order, and petitioners are "aggrieved" by it. Because it threatens them with economic injury, they "had the requisite standing to appeal and to raise * * * any relevant question of law in respect of the order * * *." *Federal Communications Commission* v. *Sanders Brothers Radio Station*, 309 U.S. 470, 477.

Petitioners are national or international labor unions which intervened, with some of their members, in the proceedings before the Commission, on the basis that "granting the conditional construction permit herein (1) is a violation of the provisions of the Atomic Energy Act of 1954, and the regulations pursuant thereto adopted by the Commission * * * and (2) will result in the construction of a reactor which, under present technological conditions, is inherently unsafe, and which will thereby create a hazard which will place the individual Intervenors, the members of the UAW and their families, and the UAW in danger of an explosion or other incident" damaging to the individuals and their homes, real estate values, and employment; that the value of collective bargaining

contracts "will be seriously impaired if the PRDC reactor is built in this area without reasonable assurances of safety"; and that there are "reasonable grounds for [b]elief that a license to operate said facility when it is completed, with an expenditure of $45,000,000 will be issued without proper consideration of and regard for the health and safety of the public."

In their reply brief in this court, petitioners contend that "The fear of a possible atomic catastrophe, in itself, before any operation would begin, would, among other things have the effect of depressing values of property owned by the Petitioners, and would cause plants in which they work under collective bargaining agreements to move and thereby cause a loss of employment." Their reply brief asserts that "the uncontroverted allegations of their petition for intervention before the Commission set forth the economic injury they would suffer merely from the construction of the reactor itself." But we find no such allegations in their petition for intervention before the Commission. The theory of that petition was that construction would cause operation, and operation would cause injury, not that construction without operation would cause injury.[1] Judicial review is limited to the record before the Commission. 5 U.S.C. § 1037(a).

As the Commission says in its order, "a construction permit is a step toward a license rather than the equivalent thereof. * * * This permit is provisional to the extent that a license authorizing operation of the facility will not be issued by the Commission unless PRDC has submitted to the Commission (by

[1] It is undisputed that construction without operation will cause no *physical* injury or danger not involved in the erection of any large building.

proposed amendment to the Application) the complete, final Hazards Summary Report (portions of which may be submitted and evaluated from time to time), and the Commission has found that the final design provides reasonable assurance that the health and safety of the public will not be endangered by operation of the facility in accordance with the specified procedures. It is further provisional to the extent that the Commission reserves jurisdiction, at any time prior to issuance of an operating license, upon notice to the parties herein, to reopen this proceeding for the purpose of receiving additional evidence, and to make such determinations and take such action with respect to the continuance, vacation, or modification of this permit as the entire record warrants." But the order also says: "There is reasonable assurance that theoretical and experimental programs under way will develop sufficient data to justify the issuance of an operating license, and that the results of these programs will be available prior to the time it is necessary for the Commission to rule on the operating aspect of the PRDC license Application." PRDC says "it must be taken as settled * * * that the further technical information needed to complete the PRDC application for license will be supplied." Although this positive prediction overstates the matter, it is plainly probable, in a high degree, that if the construction permit stands PRDC will get an operating license and will operate. We think petitioners are therefore aggrieved by the issuance of the permit.

Safety Findings Required by the Atomic Energy Act

Petitioners contend that "The Act and the regulations of the Commission * * * require, as conditions precedent to the issuance of every construction permit

for an atomic energy power reactor, that *as of the time the construction permit is issued* the Commission find that (1). it has reasonable assurance that the reactor may be constructed *and operated* at the proposed site without undue risk to the health and safety of the public * * * ."

It is undisputed that the Commission must make such a finding when it authorizes operation. The question is whether it must make such a finding when it authorizes construction. In our opinion it must.

Section 182 of the Atomic Energy Act of 1954, which is headed "License applications", provides in paragraph (a): "* * * In connection with applications for licenses to operate production or utilization facilities, the applicant shall state such technical specifications, including * * * the place of the use * * * and such other information as the Commission may, by rule or regulation, deem necessary in order to enable it to find that the utilization or production of special nuclear material * * * will provide adequate protection to the health and safety of the public. Such technical specifications shall be a part of any license issued. * * *" 42 U.S.C. § 2232(a).

It seems to be unquestioned that the phrase used in § 182, "adequate protection to the health and safety of the public", and the Commission's phrase, "without undue risk to the health and safety of the public," are substantially equivalent.

Section 185 of the Act, which is headed "Construction permits", provides: "All applicants for licenses to construct or modify production or utilization facilities shall, if the application is otherwise acceptable to the Commission, be initially granted a construction permit. * * * Upon the completion of the construction or modification of the facility, upon the filing of any additional information needed to bring the orig-

inal application up to date, and upon finding that the facility authorized has been constructed and will operate in conformity with the application as amended and in conformity with the provisions of this chapter and of the rules and regulations of the Commission, and in the absence of any good cause being shown to the Commission why the granting of a license would not be in accordance with the provisions of this Act, the Commission shall thereupon issue a license to the applicant. For all other purposes of this Act a construction permit is deemed to be a 'license'." 42 U.S.C. § 2235.

While the bill was pending, Senator Humphrey proposed, and withdrew, an amendment which would have added after the word "license", at the end of § 185: ", and no construction permit shall be issued by the Commission until after the completion of the procedures established by Section 182 for the consideration of applications for licenses under this act." (100 CONG. REC. 11566 (1954); Legislative History of the Atomic Energy Act of 1954, Vol. III, p. 3759; Vol. I, p. 733) He said: "*The purpose of the amendment* when it was prepared *was to make sure that the construction of a facility was not permitted prior to the authorization of a license,* because had that been done what it would have amounted to would be getting an investment of a substantial amount of capital, which surely would have been prejudicial in terms of the Commission issuing the license. In other words, if the Commission had granted the construction permit for some form of nuclear reactor, and then the question of a license was not fully resolved, surely there would have been considerable pressure, and justifiably so, for the Commission to have authorized the license once it had authorized the permit for construction.

"The chairman of the committee tells me he has modified certain sections by the committee amendments to the bill, of which at that time I was not aware. *The chairman indicates to me that under the terms of the bill, as amended, the construction permit is equivalent to a license.* In other words, as I understand, under the bill a construction permit cannot be interpreted in any other way than being equal to or a part of the licensing procedure. Is that correct?" Senator Hickenlooper, the manager of the bill, replied: "The Senator is correct. The staff has worked on this matter. * * * A license and a construction permit are equivalent. * * * Therefore, we believe, and we assure the Senator, that *the amendment is not essential to the problem which he is attempting to reach.*" After some discussion of other sections of the bill, this colloquy occurred: "Mr. HUMPHREY. In other words, the revised sections on judicial review and on hearings and *the revised section 182 on license application all apply directly to construction permits?* Mr. HICKENLOOPER. *Yes.* Mr. HUMPHREY. *With that statement, Mr. President, I withdraw my amendment. The only purpose of the amendment was to clarify that section.* I am grateful to the chairman for having done it before the amendment was considered." [Emphasis added.] (100 CONG. REC. 11566; Legislative History, Vol. III, p. 3759.)[2]

If, as this indicates, § 182 applies "directly to" construction permits, when the Commission issues a construction permit it must "find that the utilization or production of special nuclear material * * * will provide adequate protection to the health and safety of

[2] The Commission apparently interprets this colloquy as concerning only the "procedural safeguards" of notice, hearings, and appeal. We cannot so understand it and cannot suppose the Senate so understood it.

the public"; or, in the Commission's phrase, that the facility can be "operated at the location proposed without undue risk to the health and safety of the public."

The Joint Committee on Atomic Energy said in its report on the bill: "Section 185 permits the Commission to issue construction permits to applicants for a production or utilization facility, describes the terms of the construction permit, and requires the issuance of a license if the construction is carried out in accordance with the terms of the construction permit." (S. Rep. No. 1699, 83d Cong., 2d Sess., 28 (1954); Legislative History, Vol. I, p. 776.) It seems certain that if the Act did not require, as a condition to the issuance of a construction permit, a finding that the proposed facility can be operated without undue risk to the health and safety of the public, the Act would not require the issuance of a license when the permitted construction is carried out.

At the very least it is doubtful whether the Commission's construction of the Atomic Energy Act is correct. The possibilities of harm are so enormous that any doubt as to what findings the Act requires, and any doubt as to whether the Commission made such findings, should be resolved on the side of safety.

The Commission's Safety Findings

In our opinion the Commission's findings regarding safety of operation are not sufficient.

An Initial Decision dated December 10, 1958, contains this unqualified finding: "22. The Commission finds reasonable assurance in the record that a utilization facility of the general type proposed in the PRDC application and amendments thereto can be constructed and will be able to be operated at the location proposed without undue risk to the health and

safety of the public." But in the Opinion and Final Decision which accompanied its order of May 26, 1959, by interpolating the phrase we emphasize, the Commission qualified the finding: "22. The Commission finds reasonable assurance in the record, *for the purposes of this provisional construction permit,* that a utilization facility of the general type proposed in the PRDC Application and amendments thereto can be constructed and operated at the location without undue risk to the health and safety of the public." [Emphasis added.] This is not a finding that a facility can be operated there without undue risk. It is a finding that there is sufficient likelihood that a facility can be operated there without undue risk so that, in the Commission's opinion, it is appropriate to issue a "provisional" construction permit. In our opinion such a finding does not meet the requirements of the Act.

The Commission made other statements which confirm the impression that it no longer found, as it had found in December, reasonable assurance that a facility can be operated at the location without undue risk. The Commission said: "The degree of 'reasonable assurance' with respect to safety that satisfies us in this case for purposes of the *provisional* construction permit would not be the same as we would require in considering the issuance of the *operating* license. * * * It has not been positively established that a fast breeder reactor of the general type and power level proposed by Applicant can be *operated* without a credible possibility of releasing significant quantities of fission products to the environment * * *." (Emphasis in original.) And again: "*For the purposes of a provisional construction permit,* there is reasonable assurance that a reactor of the general type described in the Application can be so designed that

no credible accident in the course of its operation is likely to result in the release of significant quantities of fission products into the atmosphere." (Emphasis added.)

The Commission expressed confidence that future scientific developments would enable it, in the future, to find that the reactor could be operated without undue risk. It said: "There is reasonable assurance that theoretical and experimental programs under way will develop sufficient data to justify the issuance of an operating license, and that the results of these programs will be available prior to the time it is necessary for the Commission to rule on the operating aspect of the PRDC license Application." "There is reasonable assurance that theoretical and experimental investigations which have been undertaken, together with operating experience on one or more of the EBR–I, EBR–II and Dounreay reactors, will establish definitively, prior to the scheduled completion date of the PRDC reactor, whether or not the reactor proposed by Applicant can be so operated"; *i.e.*, whether it can be "operated without a credible possibility of releasing significant quantities of fission products to the environment." Again, "there is reasonable assurance that *evidence will establish* that the reactor proposed by Applicant can be so operated." [Emphasis added.] This clearly implies that *evidence does not now establish* that the reactor can be so operated. The Commission's predictions regarding the future course of scientific development do not in our opinion satisfy the requirement of the Act.

The Commission said: "It is in the nature of reactor design, although certainly not unique to it, that many features remain to be designed and demonstrated after construction is begun—and indeed some features redesigned and replaced after operation is under way. * * *

By proceeding with construction and further research and development simultaneously, rather than awaiting complete research and development results Applicant will save several years in the time required to place in operation its demonstration power reactor." As a matter of policy, there is force in these considerations. But Congress seems to have been more impressed by the opposite policy considerations to which Senator Humphrey, in his colloquy with Senator Hickenlooper, called the attention of the Senate. The economy cannot afford to invest enormous sums in the construction of an atomic reactor that will not be operated. If enormous sums are invested without assurance that the reactor can be operated with reasonable safety, pressure to permit operation without adequate assurance will be great and may be irresistible. PRDC's estimate of the cost of construction, preconstruction research and development, and administrative expenses during construction and test operation was $44,020,000. The Commission found there would probably be "a cost over-run."

In contrast with the Commission's repeated expressions of uncertainty, it used other expressions which might seem to indicate a positive opinion regarding safety of operation. The Opinion and Final Decision, before adverting to the issue of safety and other issues, said broadly: "we amplify and affirm our Opinion and Initial Decision dated December 10, 1958." The Commission also said: "The principal factual issue in this proceeding is whether there is information sufficient to provide a reasonable assurance that a utilization facility of the general type proposed in the PRDC application can be constructed and operated at the location proposed therein without undue risk to the health and safety of the public. Subsidiary to this issue is whether there is reasonable assur-

ance that technical information omitted from, and required to complete, the application will be supplied before issuance of an operating license. A careful evaluation of the entire record in this proceeding can only lead to an affirmative answer to all of these questions." And again: "It is enough for the purposes of the present proceeding (that is, for the issuance of a provisional construction permit), and for the satisfaction of the requirements of the statute and the regulations, that there be reasonable assurance that the reactor can be constructed and operated without undue risk to the health and safety of the public. We conclude that the present state of knowledge as described in the record gives, and the accident possibilities presented on the record do not negate, that assurance."

It results that the Commission's findings regarding safety of operation are ambiguous. In view of the nature, size, and location of the project, we think the findings should be uncommonly free from ambiguity. The Commission should "make the basis of its action reasonably clear. We cannot find that it did so here." *Radio Station KFH Co.* v. *Federal Communications Commission*, 101 U.S. App. D.C. 164, 166, 247 F. 2d, 570, 572. "'We must know what a decision means before the duty becomes ours to say whether it is right or wrong.'" *Secretary of Agriculture* v. *United States*, 347 U.S. 645, 654. *Pacific Far East Line, Inc.* v. *Federal Maritime Board*, — U.S. App. D.C. —, —, 275 F. 2d 184, 187.

We think the Commission's safety findings are deficient in an additional respect.

In 1957 the Commission made to the Joint Committee on Atomic Energy "a report of a study of the possible consequences in terms of injury to persons and damage to property, if certain hypothetical major accidents should occur in a typical large nuclear power

reactor." All the experts agreed "that the chances that major accidents might occur are exceedingly small." But "Under adverse combinations of the conditions considered, it was estimated that people could be killed at distances up to fifteen miles, and injured at distances of about forty-five miles. Land contamination could extend for greater distances." Undisputed testimony before the Commission shows that there is a "possibility of a major disaster, even though it has a low probability."

As the Commission said, "the question of safety obviously cannot be considered without regard to proposed location." The Commission found: "The site is bordered on one side by water and provides an exclusion area on the land side with a minimum radius of 2,900 feet. The population distribution for given distances from the site is as follows: 1 mile, population 175; 2, 600; 5, 1,800; 10, 31,300; 20, 187,100; 30, 2,001,700. During the summer months the population within five miles would be increased due to vacationing transients and to the fact that beaches two to five miles southwest of the site may be crowded with thousands of people."

We think it clear from the Congressional concern for safety that Congress intended no reactor should, without compelling reasons, be located where it will expose so large a population to the possibility of a nuclear disaster. It does not appear that the Commission found compelling reasons or saw that such reasons were necessary. It said: "The evidence of record with respect to site gives reasonable assurance that the site is satisfactory from structural and underground water flow standpoints. The meteorology of the site is complex, but no reason appears in the record for it to be disqualifying. The site makes possible extensive safeguards against the inadvertent

release of liquid contaminants. * * * Studies of weather, hydrology, geology, and similar problems have yielded considerable information and are still in progress. Although the data of these types are not yet complete or conclusive, the record gives reasonable assurance that safe operation of the reactor will be as likely in that location as in any other location."[3] We think this finding clearly insufficient. We need not consider whether even the most compelling reasons for preferring this location could support a finding that the reactor could be operated at this location without "undue" risk, or with "adequate" protection, to the health and safety of the public.

Because we think the safety findings insufficient, we must set aside the Commission's grant of a construction permit and remand the case for such further proceedings consistent with this opinion as the Commission may determine. We need not consider other points raised by the petitioners.

BURGER, *Circuit Judge, dissenting:* I dissent because I think there is no occasion at this time for the court to reach the issue of the ultimate safety of the plant's operations. The Commission has issued only a provisional permit to build a plant, not to operate it. The plant cannot go into operation until

[3] The Commission continued: "We anticipate that knowledge to be acquired will fortify that assurance. * * * It is possible that there may be presently unknown effects in large fast reactor systems. A prototype of the proposed reactor at a remote location has been urged as affording greater assurance against the possibility of such unknown effects than does the presently planned experimental and theoretical programs. (sic) The Commission finds that the necessity, however, for constructing such a prototype has not been shown. If the program of meltdown investigation should prove inconclusive, it will be necessary to reconsider the question of need for a prototype."

and unless the intervenor PRDC meets the safety provisions of the Act.

The sole basis of challenge to the provisional construction permit is that the *future possibility* that an operating permit will be unlawfully and improperly issued by the Commission creates a "present," "immediate" and "unavoidable threat" of injury. I do not think we have any occasion to consider what is not now before us. The Commission expressly deferred action on that issue. This does not appear to me a "final order" which gives us jurisdiction to pass on the ultimate issue of safety; nor does it empower us to tell the Commission that it must pass on the ultimate safety of the operation before the plant is constructed. Orders are not final as to a person "unless and until they impose an obligation, deny a right or fix some legal relationship as a consummation of the administrative process." *Chicago & Southern Air Lines, Inc.* v. *Waterman Steamship Corp.*, 333 U.S. 103, 113 (1948).

In an area involving as much scientific uncertainty as development of nuclear energy for peaceful purposes, the Commission must be permitted to proceed step by step, *i.e.*, make its preliminary finding of probable safety when the construction permit issues and reserve final approval of operations until a later date.

I respectfully suggest that my colleagues are undertaking to assume responsibilities which Congress vested in the Commission. This is illustrated in the majority's statement

> "No reactor should, without compelling reasons, be located where it will expose so large a population to the possibility of a nuclear disaster."

On what evidence does the majority make a finding of "nuclear disaster" directly opposed to the finding which the Atomic Energy Commission made? The

majority is, in effect telling the Atomic Energy Commission that it has made an *unwise* decision on the location of the plant.

The majority also goes beyond the established limits of judicial review when it states:

> "The economy cannot afford to invest enormous sums in the construction of an atomic reactor that will not be operated. If enormous sums are invested without assurance that the reactor can be operated with reasonable safety, pressure to permit operation without adequate assurance will be great and may be irresistible."

From an erroneous premise drawn out of thin air, the majority proceeds to draw an unwarranted conclusion. On what evidence can we as judges say our "economy cannot afford," or even that these appellees cannot afford, this large investment for peaceful uses of nuclear energy? I suggest our entire history is to the contrary. We invested not mere millions but *billions* in the original development of nuclear fission on a totally unproven theory of physics. It was an act of faith in the views of scientists. Surely it cannot be seriously suggested that these giants of American industry which formed PRDC are not well able—and willing—to risk the loss of millions in experiments and research. Forty or fifty million dollars to the sponsors of PRDC is a small investment to risk for the world's first known experiment of this kind into peaceful uses of nuclear energy.

If we were dealing with a radio or TV license or some other purely commercial enterprise in a developed and mature industry I would agree that there is a risk that large investment in machines might conceivably exert a subtle influence on the ultimate grant of an operations permit. Cf. *Community Broadcasting Co. v. Federal Communications Commission*, Nos. 15313, 15314 (D.C. Cir., Feb. 8,

1960). But I cannot join in the suggestion that members of the Atomic Energy Commission who have assumed obligations under oaths as binding as ours would permit an operation dangerous to the public because 40 or 50 million dollars is invested in brick, mortar and steel by men who knew from the outset they were engaged in a scientific gamble. And if any administrative agency should so abdicate its responsibilities in a matter as grave as this—which I cannot believe is likely—the courts are always in a position to exercise a final and stringent scrutiny on the issue of public safety.

Development in an area like this must, of necessity, proceed step by step. The Commission has found that the issuance of the construction permit on a provisional and restricted basis "does not in any manner adversely affect the health and safety of the public or that of the [petitioners]." The appellants do not attack this finding.

At this stage how can anyone know what the result will be? This court considered a challenge not unlike that of appellants' challenge in *Associated-Banning Co. v. United States*, 247 F. 2d 557, 561 (1957): "We cannot assume that the Board will not conduct its hearing within the intendment of the Act, so far as it may apply. It may well be, for all we are shown, that the Board's ultimate action will completely dispel every prospective fear voiced by the protest and the complaint. It is clear that the Board has not as yet entered an order 'final' as to these petitioners."

The essence of the majority action is found in its acceptance of the idea that once the Commission has permitted PRDC to invest its millions in the plant they are "bound" or "likely" to relax their notion of what is safe or dangerous in order to bail out the investors.

I emphasize that I cannot for a moment believe the sponsors of PRDC are so naive that they would think their investment of these millions is not speculative just as is most research. Nor can I believe they think that any amount of invested capital will persuade the Atomic Energy Commission to make a finding of safety which is not supported by substantial scientific evidence. It is entirely possible that PRDC might find itself the owner of a 50 million dollar scientific "white elephant" if, after completion of construction, it cannot satisfy the safety standards of the statute. Should that be the case it will be simply one of the unproductive steps in what promises to be a program to open to mankind sources of power undreamed of only a few years ago.

Statute and Regulations Involved

1. The Atomic Energy Act of 1954, 68 Stat. 919, as amended, 42 U.S.C. 2011 *et seq.*, provides in pertinent part:

Sec. 1. Declaration.—Atomic energy is capable of application for peaceful as well as military purposes. It is therefore declared to be the policy of the United States that—

> a. the development, use, and control of atomic energy shall be directed so as to make the maximum contribution to the general welfare, subject at all times to the paramount objective of making the maximum contribution to the common defense and security; and
>
> b. the development, use, and control of atomic energy shall be directed so as to promote world peace, improve the general welfare, increase the standard of living, and strengthen free competition in private enterprise.

* * * * *

SEC. 3. PURPOSE.—It is the purpose of this Act to effectuate the policies set forth above by providing for—

a. a program of conducting, assisting, and fostering research and development in order to encourage maximum scientific and industrial progress;

* * * * *

d. a program to encourage widespread participation in the development and utilization of atomic energy for peaceful purposes to the maximum extent consistent with the common defense and security and with the health and safety of the public;

* * * * * *

SEC. 104. MEDICAL THERAPY AND RESEARCH AND DEVELOPMENT.—

a. The Commission is authorized to issue licenses to persons applying therefor for utilization facilities for use in medical therapy. In issuing such licenses the Commission is directed to permit the widest amount of effective medical therapy possible with the amount of special medical nuclear material available for such purposes and to impose the minimum amount of regulation consistent with its obligations under this Act to promote the common defense and security and to protect the health and safety of the public.

b. The Commission is authorized to issue licenses to persons applying therefor for utilization and production facilities involved in the conduct of research and development activities leading to the demonstration of the practical value of such facilities for industrial or commercial purposes. In issuing licenses under this subsection, the Commission shall impose the minimum amount of such regulations and terms of license as will permit the Commission to fulfill its obligations under this Act to promote the common defense and security and to protect the health and

safety of the public and will be compatible with the regulations and terms of license which would apply in the event that a commercial license were later to be issued pursuant to section 103 for that type of facility. In issuing such licenses, priority shall be given to those activities which will, in the opinion of the Commission, lead to major advances in the application of atomic energy for industrial or commercial purposes.

c. The Commission is authorized to issue licenses to persons applying therefor for utilization and production facilities useful in the conduct of research and development activities of the types specified in section 31 and which are not facilities of the type specified in subsection 104b. The Commission is directed to impose only such minimum amount of regulation of the licensee as the Commission finds will permit the Commission to fulfill its obligations under this Act to promote the common defense and security and to protect the health and safety of the public and will permit the conduct of widespread and diverse research and development.

d. No license under this section may be given to any person for activities which are not under or within the jurisdiction of the United States, except for the export of production or utilization facilities under terms of an agreement for cooperation arranged pursuant to section 123 or except under the provisions of section 109. No license may be issued to any corporation or other entity if the Commission knows or has reason to believe it is owned, controlled, or dominated by an alien, a foreign corporation, or a foreign government. In any event, no license may be issued to any person within the United States, if, in the opinion of the Commission, the issuance of a license to such person would be inimical to the

common defense and security or to the health and safety of the public.

* * * * *

SEC. 161. GENERAL PROVISIONS.—In the performance of its functions the Commission is authorized to—

* * * * *

b. establish by rule, regulation, or order, such standards and instructions to govern the possession and use of special nuclear material, source material, and byproduct material as the Commission may deem necessary or desirable to promote the common defense and security or to protect health or to minimize danger to life or property.

* * * * *

i. prescribe such regulations or orders as it may deem necessary * * * (3) to govern any activity authorized pursuant to this Act, including standards and restrictions governing the design, location, and operation of facilities used in the conduct of such activity, in order to protect health and to minimize danger to life or property.

* * * * *

q. make, promulgate, issue, rescind, and amend such rules and regulations as may be necessary to carry out the purposes of this Act.

* * * * *

SEC. 181. GENERAL.—The provisions of the Administrative Procedure Act (Public Law 404, Seventy-ninth Congress, approved June 11, 1946) shall apply to all agency action taken under this Act, and the terms "agency" and "agency action" shall have the meaning specified in the Administrative Procedure Act: *Provided, however,* That in the case of agency proceedings or actions which involve Restricted Data or defense information, the Commission shall provide

by regulation for such parallel procedures as will effectively safeguard and prevent disclosure of Restricted Data or defense information to unauthorized persons with minimum impairment of the procedural rights which would be available if Restricted Data or defense information were not involved.

SEC. 182 [as amended, 70 Stat. 1069 and 71 Stat. 579]. LICENSE APPLICATIONS.—

a. Each application for a license hereunder shall be in writing and shall specifically state such information as the Commission, by rule or regulation, may determine to be necessary to decide such of the technical and financial qualifications of the applicant, the character of the applicant, the citizenship of the applicant, or any other qualifications of the applicant as the Commission may deem appropriate for the license. In connection with applications for licenses to operate production or utilization facilities, the applicant shall state such technical specifications, including information of the amount, kind, and source of special nuclear material required, the place of the use, the specific characteristics of the facility, and such other information as the Commission may, by rule or regulation, deem necessary in order to enable it to find that the utilization or production of special nuclear material will be in accord with the common defense and security and will provide adequate protection to the health and safety of the public. Such technical specifications shall be a part of any license issued. The Commission may at any time after the filing of the original application, and before the expiration of the license, require further written statements in order to enable the Commission to determine whether the application should be granted or denied or whether a license should be modified or revoked. All applications and statements shall be signed by the applicant or licensee. Applications for, and statements made

in connection with, licenses under sections 103 and 104 shall be made under oath or affirmation. The Commission may require any other applications or statements to be made under oath or affirmation.

b. The Advisory Committee on Reactor Safeguards shall review each application under section 103 or 104b. for a license for a facility, any application under section 104c. for a testing facility, and any application under section 104a. or c. specifically referred to it by the Commission, and shall submit a report thereon, which shall be made part of the record of the application and available to the public, except to the extent that security classification prevents disclosure.

c. The Commission shall not issue any license for a utilization or production facility for the generation of commercial power under section 103, until it has given notice in writing to such regulatory agency as may have jurisdiction over the rates and services of the proposed activity, to municipalities, private utilities, public bodies, and cooperatives within transmission distance authorized to engage in the distribution of electric energy and until it has published notice of such application once each week for four consecutive weeks in the Federal Register, and until four weeks after the last notice.

d. The Commission, in issuing any license for a utilization or production facility for the generation of commercial power under section 103, shall give preferred consideration to applications for such facilities which will be located in high cost power areas in the United States if there are conflicting applications for a limited opportunity for such license. Where such conflicting applications resulting from limited opportunity for such license include

those submitted by public or cooperative bodies such applications shall be given preferred consideration.

* * * * *

SEC. 185. CONSTRUCTION PERMITS.—All applicants for licenses to construct or modify production or utilization facilities shall, if the application is otherwise acceptable to the Commission, be initially granted a construction permit. The construction permit shall state the earliest and latest dates for the completion of the construction or modification. Unless the construction or modification of the facility is completed by the completion date, the construction permit shall expire, and all rights thereunder be forfeited, unless upon good cause shown, the Commission extends the completion date. Upon the completion of the construction or modification of the facility, upon the filing of any additional information needed to bring the original application up to date, and upon finding that the facility authorized has been constructed and will operate in conformity with the application as amended and in conformity with the provisions of this Act and of the rules and regulations of the Commission, and in the absence of any good cause being shown to the Commission why the granting of a license would not be in accordance with the provisions of this Act, the Commission shall thereupon issue a license to the applicant. For all other purposes of this Act, a construction permit is deemed to be a "license".

* * * * *

SEC. 189. HEARINGS AND JUDICIAL REVIEW.—

a. In any proceeding under this Act, for the granting, suspending, revoking, or amending of any license or construction permit, or application to transfer con-

trol, and in any proceeding for the issuance or modification of rules and regulations dealing with the activities of licensees, and in any proceeding for the payment of compensation, an award or royalties under sections 153, 157, 186c., or 188, the Commission shall grant a hearing upon the request of any person whose interest may be affected by the proceeding, and shall admit any such person as a party to such proceeding. The Commission shall hold a hearing after thirty days notice and publication once in the Federal Register on each application under section 103 or 104b. for a license for a facility, and on any application under section 104c. for a license for a testing facility.[4]

(b) Any final order entered in any proceeding of the kind specified in subsection a. above shall be subject to judicial review in the manner prescribed in the Act of December 29, 1950, as amended (ch. 1189, 64 Stat. 1129), and to the provisions of section 10 of the Administrative Procedure Act, as amended.

* * * * *

SEC. 201. MEMBERSHIP.—There is hereby established a Joint Committee on Atomic Energy to be composed of nine Members of the Senate to be appointed by the President of the Senate, and nine Members of the House of Representatives to be appointed by the Speaker of the House of Representatives. In each instance not more than five Members shall be members of the same political party.

SEC. 202. AUTHORITY AND DUTY.—The Joint Committee shall make continuing studies of the activities of the Atomic Energy Commission and of problems relating to the development, use, and control of atomic energy. During the first sixty days of each session of

[4] Public Law 85-256 (71 Stat. 576, 579) amended Sec. 189 by adding the last sentence to subsec. a.

the Congress, the Joint Committee shall conduct hearings in either open or executive session for the purpose of receiving information concerning the development, growth, and state of the atomic energy industry. The Commission shall keep the Joint Committee fully and currently informed with respect to all of the Commission's activities. The Department of Defense shall keep the Joint Committee fully and currently informed with respect to all matters within the Department of Defense relating to the development, utilization, or application of atomic energy. Any Government agency shall furnish any information requested by the Joint Committee with respect to the activities or responsibilities of that agency in the field of atomic energy. All bills, resolutions, and other matters in the Senate or the House of Representatives relating primarily to the Commission or to the development, use, or control of atomic energy shall be referred to the Joint Committee. The members of the Joint Committee who are Members of the Senate shall from time to time report to the Senate, and the members of the Joint Committee who are Members of the House of Representatives shall from time to time report to the House, by bill or otherwise, their recommendations with respect to matters within the jurisdiction of their respective Houses which are referred to the Joint Committee or otherwise within the jurisdiction of the Joint Committee.

* * * * *

2. The Judicial Review Act of 1950, 64 Stat. 1129 as amended, 5 U.S.C. 1031, *et seq.*, provides in pertinent part:

> SEC. 2 [as amended, 68 Stat. 961]. The court of appeals shall have exclusive jurisdiction to enjoin, set aside, suspend (in whole or in part), or to determine the validity of, all final

orders * * * (d) of the Atomic Energy Commission made reviewable by section 189 of the Atomic Energy Act of 1954, as amended.

Such jurisdiction shall be invoked by the filing of a petition as provided in section 4 hereof.

SEC. 3. The venue of any proceeding under this Act shall be in the judicial circuit wherein is the residence of the party or any of the parties filing the petition for review, or wherein such party or any of such parties has its principal office, or in the United States Court of Appeals for the District of Columbia.

SEC. 4. Any party aggrieved by a final order reviewable under this Act may, within sixty days after entry of such order, file in the court of appeals, wherein the venue as prescribed by section 3 hereof lies, a petition to review such order. Upon the entry of such an order, notice thereof shall be given promptly by the agency by service or publication in accordance with the rules of such agency. The action in court shall be brought against the United States. The petition shall contain a concise statement of (a) the nature of the proceedings as to which review is sought, (b) the facts upon which venue is based, (c) the grounds on which relief is sought, and (d) the relief prayed. * * *

* * * * * *

3. The regulations of the Atomic Energy Commission, 10 CFR, provide in pertinent part:

SECTION 2.102 *Action on applications, hearings.* (a) The AEC will, upon request of the applicant or an intervener, and may upon its own initiative, direct the holding of a formal hearing prior to taking action on the application. If no prior formal hearing has been held and no notice of proposed action has been served as provided in paragraph (b) of this section, AEC will direct the holding of a formal hearing upon receipt of a request therefor from the applicant or an intervener within 30 days

after the issuance of a license or other approval or a notice of denial.

(b) In such cases as it deems appropriate, AEC may cause to be served upon the applicant, and published, a notice of proposed action upon his application and shall cause copies thereof to be served upon interveners or others entitled to or requesting notification. The notice shall state the terms of the proposed action. If a formal hearing has not been held prior to issuance of the notice, AEC will direct the holding of a formal hearing upon the request of the applicant or an intervener received within fifteen days following the service of the notice.

* * * * * *

SECTION 50.34 *Contents of applications; technical information hazards summary report.* Each application shall state the following technical information:

(a) A description of the chemical, physical, metallurgical, or nuclear process to be performed, and a statement of the kind and quantity of any radioactive effluent expected to result from the process. The description of the process should be sufficiently detailed to permit evaluation of the radioactive hazards involved. The magnitude of the proposed operation should be indicated in terms of the amount and radioactivity of source, special nuclear, or by-product material to be handled per unit of time, and thermal power to be generated if any.

(b) A description of the facility. The description should be based on the design criteria for the facility as a whole and for those major component parts which are essential to the safe operation of the facility, and should be presented in sufficient detail to allow an evaluation of the adequacy of the various means proposed to minimize the probability of danger from radioactivity to persons both on and off-site. The description should also cover any activities, other than those subject to license, proposed to

be carried on in the building which will house the facility and on the balance of the site.

(c) A description of the site on which the facility is to be located. This should include a map of the area showing the location of the site and indicating the use to which the surrounding land is put, i.e., industrial, commercial, agricultural, residential; location of sources of potable or industrial water supply, watershed areas and public utilities; and a scale plot plan of the site showing the proposed location of the facility.

(d) A description of proposed procedures for: routine and non-routine operations, start-up and shut-down, maintenance, storage, training of employees, minimizing operational mishaps (such as locked controls, checklists, and close supervision), investigating unusual or unexpected incidents; and a description of such other details as may be useful in evaluating the existence and effectiveness of safeguards against the radioactive hazards in the operation of the facility.

(e) A description of plans or proposals in the event that acts or accidents occur which would create radioactive hazards. The description should relate the various operational procedures, the protective devices, and the pertinent features of the site, to such happenings as operational mistakes, equipment or instrument failure or malfunction, fire, electric power failure, flood, earthquake, storm, strike, and riot.

(f) Meteorological, hydrological, geological, and seismological data necessary for evaluating the measures proposed for protecting the public against possible radioactive hazards.

(g) An evaluation of the proposed measures and devices to prevent acts or accidents which would create radioactive hazards or to protect against the consequences should such acts or accidents occur.

(h) A description of procedures for disposal of radioactive solid waste and the final disposal of liquid waste effluent.

(i) A description of means provided to sample atmosphere discharges through stacks where such stacks may emit by-product material or special nuclear material.

SECTION 50.35 *Extended time for providing technical information.* Where, because of the nature of a proposed project, an applicant is not in a position to supply initially all of the technical information otherwise required to complete the application, he shall indicate the reason, the items or kinds of information omitted, and the approximate times when such data will be produced. If the Commission is satisfied that it has information sufficient to provide reasonable assurance that a facility of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public and that the omitted information will be supplied, it may process the application and issue a construction permit on a provisional basis without the omitted information subject to its later production and an evaluation by the Commission that the final design provides reasonable assurance that the health and safety of the public will not be endangered.

* * * * *

RELATION TO POPULATION CENTERS OF POWER REACTORS IN OPERATION OR UNDER CONSTRUCTION [5]

A. LICENSED REACTORS

1. Commonwealth Edison Co., Morris, Ill., operating license issued, 626,000 thermal kilowatts: 14 miles

[5] Population figures are taken from applications filed with the Commission to initiate licensing proceedings (for licensed facilities), or technical reports used in authorization proceed-

from Joliet, 47 miles southwest of downtown Chicago; population within 5 miles—2,600, within 25 miles—192,000.

2. General Electric Co., Vallecitos, Calif., operating license issued, 30,000 thermal kilowatts: 33 miles east-southeast of San Francisco; population within 10 miles—22,000, within 25 miles—250,000.

3. Carolinas-Virginia Nuclear Power Associates, Inc., Parr, S.C., provisional construction permit issued, 60,500 thermal kilowatts: 25 miles northwest of Columbia, S.C.; population within 5 miles—15 per square mile, within 10 miles—25 per square mile.

4. Consolidated Edison Co., Indian Point, N.Y., provisional construction permit issued, 795,000 thermal kilowatts: 24 miles north of New York City; population within 5 miles—45,000.

5. Consumers Power Co., Big Point Rock, Mich., provisional construction permit issued, 240,000 thermal kilowatts: 85 miles southwest of Sault Ste. Marie, 165 miles north of Grand Rapids; population within 5 miles—4,964, within 20 miles—26,700, within 40 miles—52,000.

6. Northern States Power Co., Sioux Falls, South Dakota, provisional construction permit issued, 203,000 thermal kilowatts: 5.5 miles from center of Sioux Falls; population within 5 miles—10,000, within 10 miles—60,000, within 40 miles—175,000.

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ings (for Commission-owned reactors to be operated by local public bodies). The Shippingport data is taken from a Commission publication in 1957, describing the plant and surrounding area.

The reactors' capacities in thermal kilowatts are given as estimated on the best available information in the Commission's February 1960 report to the Joint Committee on Atomic Energy, in connection with the annual hearings on the atomic energy industry under Section 202 of the Act.

7. Power Reactor Development Co., Lagoona Beach, Michigan, provisional construction permit issued, 304,000 thermal kilowatts: 30 miles from Detroit; population within 5 miles—1,800, within 10 miles—187,000, within 30 miles—2,001,700.

8. Saxton Nuclear Experiment Corp., Saxton, Pennsylvania, provisional construction permit issued, 20,000 thermal kilowatts: 22 miles south of Altoona, Pa., 90 miles west of Harrisburg, 100 miles east of Pittsburgh; population within 5 miles—5,627, within 10 miles—18,303.

9. Yankee Atomic Electric Co., Rowe, Mass., provisional construction permit issued, 392,000 thermal kilowatts: within 20 miles of Bennington, Vt., and Adams, Greenfield and North Adams, Mass., 40 miles east of Albany; population within 5 miles—2,036, within 20 miles—104,293.

B. GOVERNMENT-OWNED REACTORS

1. Shippingport Atomic Power Station, Shippingport, Pa., in operation, 231,000 thermal kilowatts: 25 miles from Pittsburgh (30 miles from center of Pittsburgh); population within 5 miles—20,000, within 15 miles—225,000, within 40 miles—2,800,000.

2. Consumers Public Power District, Hallam, Nebr., provisional construction authorization, 254,000 thermal kilowatts: 19 miles south of Lincoln, 65 miles southwest of Omaha; population within 5 miles—1,052, within 10 miles—6,678.

3. City of Piqua, Ohio at outskirts of Piqua, provisional construction authorization, 45,500 thermal kilowatts: 28 miles north of Dayton, 70 miles north of Cincinnati; population within 5 miles—21,000, within 25 miles—108,000.

4. Rural Cooperative Power Association, Elk River, Minn., provisional construction authorization, 73,000

thermal kilowatts: 20–35 miles northwest of St. Paul-Minneapolis; population within 5 miles—2,656, within 10 miles—7,700.

5. Puerto Rico Water Resources Authority, Punta Higuera, Puerto Rico, provisional construction authorization, 50,000 thermal kilowatts: 13 miles northwest of Mayaguez; population within 2 miles—1,400, within 15 miles—114,000.

UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

September Term, 1959

No. 15271

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL-CIO; UNITED AUTOMOBILE, AIRCRAFT AND AGRICULTURAL IMPLEMENT WORKERS OF AMERICA; AND UNITED PAPERMAKERS AND PAPERWORKERS, PETITIONERS

v.

UNITED STATES OF AMERICA AND ATOMIC ENERGY COMMISSION, RESPONDENTS

POWER REACTOR DEVELOPMENT COMPANY, STATE OF MICHIGAN, INTERVENORS

On Petition to Review an Order of the Atomic Energy Commission

Before: EDGERTON, BAZELON, and BURGER, *Circuit Judges.*

JUDGMENT

This case came on to be heard on the record from the Atomic Energy Commission, and was argued by counsel.

ON CONSIDERATION WHEREOF, It is ordered and adjudged by this court that the order of the Atomic Energy Commission on review in this case is set aside, and that this case is remanded to the said

Atomic Energy Commission for such further proceedings consistent with the opinion of this court as the Commission may determine.

Per Circuit Judge Edgerton.

Dated: June 10, 1960.

Separate dissenting opinion by Circuit Judge Burger.

UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

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v.

UNITED STATES OF AMERICA AND ATOMIC ENERGY COMMISSION, RESPONDENTS

POWER REACTOR DEVELOPMENT COMPANY, INTERVENOR

STATE OF MICHIGAN, INTERVENOR

Before: PRETTYMAN, *Chief Judge*, EDGERTON, WILBUR E. MILLER, BAZELON, FAHY, WASHINGTON, DANAHER, BASTIAN and BURGER, *Circuit Judges*, in Chambers.

ORDER

Upon consideration of respondents' petition for a rehearing in banc, it is

ORDERED by the court that the petition for rehearing in banc is denied.

Per Curiam.

Dated: July 25, 1960.

Circuit Judges Miller and Bastian would grant the petition for rehearing in banc.

Circuit Judges Washington and Burger did not participate in this order.

UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

September Term, 1959

No. 15271

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL–CIO, UNITED AUTOMOBILE, AIRCRAFT AND AGRICULTURAL IMPLEMENT WORKERS OF AMERICA; AND UNITED PAPERMAKERS AND PAPERWORKERS, PETITIONERS

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POWER REACTOR DEVELOPMENT COMPANY, INTERVENOR

STATE OF MICHIGAN, INTERVENOR

Before: PRETTYMAN, *Chief Judge,* EDGERTON, WILBUR K. MILLER, BAZELON, FAHY, WASHINGTON, DANAHER, BASTIAN and BURGER, *Circuit Judges,* in Chambers.

ORDER

Upon consideration of the petition of intervenor Power Reactor Development Company for a rehearing in banc, it is

ORDERED by the court that the aforesaid petition is denied.

Per Curiam.

Dated: July 25, 1960.

Circuit Judges Miller and Bastian would grant the petition for rehearing in banc.

Circuit Judges Washington and Burger did not participate in this order.

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Nos. 315 and 454

IN THE

Supreme Court of the United States

OCTOBER TERM, 1960

POWER REACTOR DEVELOPMENT COMPANY, PETITIONER,

v.

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL-CIO, ET AL.

UNITED STATES OF AMERICA AND ATOMIC ENERGY COMMISSION, PETITIONER,

v.

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL-CIO, ET AL.

PETITIONS FOR A WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

BRIEF FOR INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL-CIO, ET AL. IN OPPOSITION

BENJAMIN C. SIGAL,
1126 16th Street N.W.,
Washington 6, D. C.
Attorney for Respondents.

Of Counsel:

HAROLD CRANEFIELD,
LOWELL GOERLICH.

OCTOBER, 1960.

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IN THE

Supreme Court of the United States

OCTOBER TERM, 1960

Nos. 315 and 454

POWER REACTOR DEVELOPMENT COMPANY, PETITIONER,

v.

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL-CIO, ET AL.

UNITED STATES OF AMERICA AND ATOMIC ENERGY COMMISSION, PETITIONER,

v.

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL-CIO, ET AL.

PETITIONS FOR A WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

BRIEF FOR INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL-CIO, ET AL. IN OPPOSITION

Opinion Below

The Opinion of the court below (App. B p. 42)[1] is reported at 280 F.2d 645. Petitions for a rehearing en banc

[1] This reference is to Appendix B to the petition filed by the Power Reactor Development Company, hereinafter referred to as PRDC, No. 315, this Term.

were denied without opinion by Chief Judge Prettyman, and Circuit Judges Danaher, Fahy, Edgerton and Bazelon, with Circuit Judges Bastian and Miller dissenting.

Questions Presented

1. Whether the Atomic Energy Commission violated the Atomic Energy Act of 1954 by issuing a permit for construction of an atomic energy power reactor without finding that there was information sufficient to provide reasonable assurance that the reactor could be constructed and operated at the proposed site without undue risk to the health and safety of the public.[2]

2. Whether the Commission's findings regarding its assurance that the proposed reactor can be operated safely are ambiguous and, therefore, deficient.

3. Whether the Order of the Commission is a final order which adversely affects and aggrieves Respondents.

Statement

On January 6, 1956, PRDC filed an application for a license under Section 104 (b) of the Atomic Energy Act of 1954 to design, construct, and operate a developmental fast neutron breeder reactor at Lagoona Beach, Michigan,

[2] Questions 1 and 2 stated in the petitions of PRDC (No. 315, p. 2) and the Government (No. 454, p. 2) are not presented on the record, for the record does not show, or support the contentions, that the Commission (1) had followed its uniform or settled practice in issuing the provisional construction permit herein, or (2) had made any finding in accordance with its regulation that a facility of the general type proposed could be constructed and operated at the site selected without undue risk to the health and safety of the public, or (3) that the court below holds that the Commission lacks authority to issue reactor construction permits on the basis of findings called for by its regulation, or (4) that the Act precludes the approval of a site close to a populated area unless the Commission finds there are "compelling reasons" for such location.

and also requested issuance of a construction permit for such a reactor (Tr. 5117, 5118, 5119, 5166).[3]

On June 6, 1956, the Commission's Advisory Committee on Reactor Safeguards submitted a report to the General Manager of the Commission summarizing its investigation of this proposed reactor, and concluded, in part, that "There is insufficient information available at this time to give assurance that the PRDC reactor can be operated at the site without public hazard." (Tr. 6368).

On August 4, 1956, the Commission granted a provisional construction permit to PRDC to build its proposed reactor. (Tr. 6293, 6294). The permit recognized that, "There are identified areas of uncertainty regarding the hazard potential of fast neutron breeder reactors that must be investigated and resolved. From the current state of the technology applicable to such reactors it can reasonably be inferred that there may be other areas of uncertainty not yet identified and requiring investigation and resolution." (Tr. 6292, 6293).

On or about August 31, 1956, Respondents filed petitions for intervention before the Commission, alleging, inter alia, that the construction permit granted to PRDC was issued in violation of the Act, would imperil the health and lives of thousands of Respondents' members, would imperil the homes and property of those members, as well as the property of the Respondents, would imperil the plants in which they work and earn their livelihood, would depress the value of their real estate, would influence industry to leave the areas which might be affected by an atomic castrophe, and would imperil collective bargaining agreements with employers in the area and seriously im-

[3] "Tr." refers to the original pagination of the certified transcript which is indicated in bold face in the printed Joint Appendix in the Court of Appeals.

pair their value. It was alleged, furthermore, that, by permitting the expenditure of $45 million for construction of a reactor, the issuance of the construction permit will induce the issuance of an operating permit without proper consideration of and regard for the health and safety of the Respondents and other members of the public (Tr. 6301-6304; 6314, 6315). *Neither PRDC nor the Commission challenged or denied the allegations of the Respondents' petitions for intervention.*

On October 8, 1956, the Commission granted Respondents leave to intervene, and directed that a hearing be held on issues *specified* by the Commission. The issue relating to safety was specified as follows:

> "A(1) Whether there is information sufficient to provide reasonable assurance that a utilization facility of the general type proposed by PRDC can be constructed and operated at the Lagoona Beach site without undue risk to the health and safety of the public." (Tr. 6359)

During the course of an extensive hearing that began on January 8, 1957, it was shown that the greatest potential hazard in a nuclear reactor lies in the possibility that the tremendous accumulation of radioactive fission products imprisoned in the fuel might somehow be released into the atmosphere and be distributed by wind and contaminate inhabited areas. A chain of events which could lead to a release of fission products into the atmosphere may be initiated either by a nuclear runaway or a loss of coolant, and the initial concern from a safety point of view must be, so far as is humanly possible, that such a nuclear runaway or loss of coolant cannot occur. (Tr. 4267, 4268.) These fission products are more toxic per unit of weight than any other industrially known materials by a factor of a million to a billion (Tr. 3001). An official Commission

report indicates that the possible damage from a major accident in a large nuclear power plant may run up to $7 billion, killing and maiming many thousands of people and laying waste scores of thousands of square miles of land (Tr. 4855-4892). More than two million people live within a radius of 30 miles of the site of the PRDC reactor (Tr. 7020). Considerable evidence related to the extent to which the PRDC design has solved, if at all, these serious questions and whether it was safe to build such a reactor in a heavily populated area.

On December 10, 1958, the Commission issued its initial decision affirming the provisional construction permit it had issued on August 4, 1956, and continuing it in effect with certain modifications and additions. Respondents filed exceptions thereto, including exceptions to the findings concerning safety of the proposed reactor site (Tr. 6911, 6914).

A. Decision of the Commission

On May 26, 1959, the Commission issued its Opinion and Final Decision. All exceptions taken by the Respondents were dismissed (Tr. 6937).

The principal finding of the Commission on the safety issue is that there is reasonable assurance in the record, *for the purposes of the provisional construction permit*, that a utilization facility of the general type proposed in the PRDC application and amendments thereto can be constructed and operated at the Lagoona Beach site without undue risk to the health and safety of the public. (Finding No. 22, Tr. 7020.) The Commission made no finding on the issue specified by the Commission itself, namely, whether there is sufficient information to provide reasonable assurance that a utilization facility of the general type proposed by PRDC can be constructed and operated at the Lagoona Beach site without undue risk to the health and

safety of the public. The Commission emphasized the limited nature of its finding by various statements, for example, "It has not been positively established that a fast breeder reactor of the general type and power level proposed by Applicant can be *operated* without a credible possibility of releasing significant quantities of fission products to the environment." Repeatedly the Commission emphasized that its findings on safety were limited to "the purposes of the provisional construction permit." (Tr. 6983, 6987, 7020, 7022.)

The Commission gave considerable attention to the question of the suitability of the site selected for the PRDC reactor. It arrived at the equivocal conclusion, among others, "Although the data (as to site suitability) are not yet complete or conclusive, the record gives reasonable assurance that safe operation of the reactor will be as likely in that location *as in any other location*." (Emphasis added) (Tr. 6985)

The Order of the Commission modified the original permit by establishing a procedure for continuing review of the safety characteristics of the PRDC plant.

Nowhere in its decision did the Commission state that the findings made in this case were similar to the findings made in any other construction permits issued by the Commission, or that it was following customary practice in making the kind of findings it did in this case.

B. Decision of the Court of Appeals

Standing to appeal. At the outset the court considered the contention of Petitioners that Respondents did not have standing to appeal because the Commission's order was not a final order, and the Respondents were not aggrieved by it. The court held that the Commission's order is a final order, and that the Respondents are ag-

grieved by it, and because it threatens them with economic injury Respondents have the requisite standing to appeal and to raise any relevant question of law in respect of the order, citing *Federal Communication Commission* v. *Sanders Brothers Radio Station*, 309 U.S. 470, 477.

The Court recognized that the Commission has declared that a license authorizing operation of the facility will not be issued unless PRDC has submitted to the Commission information providing reasonable assurance that the health and safety of the public will not be endangered by operation of the facility in accordance with specified procedures. The court points out, however, that the Commission stated, "There is reasonable assurance that theoretical and experimental programs under way will develop sufficient data to justify the issuance of an operating license, and that the results of these programs will be available prior to the time it is necessary for the Commission to rule on the operating aspect of the PRDC license Application." On the basis of this and other statements the court found that "it is plainly probable, in a high degree, that if the construction permit stands PRDC will get an operating license and will operate. We think petitioners are therefore aggrieved by the issuance of the permit." (App. B 45)

Safety Findings Required by the Atomic Energy Act. The court held that when the Commission authorizes construction of a reactor it must make a finding, as of the time the construction permit is issued, that the Commission has reasonable assurance that the reactor may be constructed and operated at the proposed site without undue risk to the health and safety of the public. After reviewing pertinent sections of the Act, particularly Sections 182 and 185, and significant portions of its legislative history, the court held that when the Commission issues a construction permit, it must, in accordance with Section 182,

'find that the utilization or production of special nuclear material . . . will provide adequate protection for the health and safety of the public,'' or in the Commission's phrase, that the facility can be ''operated at the location proposed without undue risk to the health and safety of the public.'' (App. B 47)

The Commission's Safety Findings. The court held that the Commission's findings regarding safety of operation are not sufficient. It pointed out that the Initial Decision dated December 10, 1958, contains this unqualified finding: ''22. The Commission finds reasonable assurance in the record that a utilization facility of the general type proposed in the PRDC application and amendments thereto can be constructed and will be able to be operated at the location proposed without undue risk to the health and safety of the public.'' (Tr. 6881). But in the Opinion and Final Decision which accompanied its order of May 26, 1959, the Commission qualified that finding as follows: ''22. The Commission finds reasonable assurance in the record, *for the purpose of this provisional construction permit*, that a utilization facility of the general type proposed in the PRDC application and amendments thereto can be constructed and operated at the location without undue risk to the health and safety of the public.'' (emphasis added) (Tr. 7020)

The court held that this is not a finding that a facility can be operated at the location selected without undue risk. The court quoted other statements of the Commission which confirmed the conclusion that it no longer found, as it had found in December, reasonable assurance that a facility can be operated at the location without undue risk (App. B 49).

The court then pointed out that the Commission also used other expressions which might seem to indicate a

positive opinion regarding the safety of operations. (App. B 50, 51) The court held, therefore, that the Commission's findings regarding safety of operation were ambiguous. The court held that the Commission should make the basis of its action reasonably clear, that it did not do so in this case, and that the court must know what a decision means before it can say whether or not it is right or wrong, citing *Secretary of Agriculture* v. *United States*, 347 U.S. 645, 654; *Radio Station KFH Co.* v. *FCC*, 101 U.S. App. D.C. 164, 166, 247 F.2d 570, 572; and *Pacific Far East Line Inc.* v. *Federal Maritime Board*, 275 F.2d 184, 187.

The court also found that the Commission's safety findings were deficient with respect to the safety of the site on which the reactor is being built. The court pointed out that the Commission after reviewing the evidence concerning the suitability of the site declared, "Although the data of these types is not yet complete or conclusive the record gives reasonable assurance that safe operation of the reactor will be as likely in that location as in any other location." The court declared that this finding was clearly insufficient in view of the absence of a finding that the reactor could be operated without undue risk to the health and safety of the public (App. B 52).

The court stated, in the course of its site discussion, that it was clear from the Congressional concern for safety that Congress intended no reactor should, without compelling reasons, be located where it will expose so large a population as is present in this situation to the possibility of a nuclear disaster, and that the Commission did not find compelling reasons for doing so in this case. However, *it did not hold that the absence of such finding was the reason for the insufficiency of the Commission's finding on site suitability.*

The court concluded that, because the safety findings were insufficient, it must set aside the Commission's grant of a construction permit, and remand the case for such further proceedings consistent with the opinion of the court as the Commission may determine.

The court did not consider other points raised by the Respondents as grounds for setting aside the Commission's Order (App. B 45).

The dissenting judge was of the opinion that the Respondents did not have standing to sue because the order of the Commission was not final. He also commented that he could not believe, as the majority of the court appeared to believe, that the members of the Commission would permit an operation dangerous to the public because $40 or $50 million is invested in brick, mortar, or steel, by men who knew from the outset they were engaged in a scientific gamble.

Argument

The decision of the court below does not present an important question of federal law which has not been, but should be, settled by this Court. Furthermore, not only is that decision not contrary to the explicit policy of the Atomic Energy Act of 1954, but clearly underscores and supports that policy. It does not invalidate any Commission regulation, nor does it affect any uniform practice followed by the Commission with regard to the issuance of construction permits for atomic reactors. It does not in any respect frustrate the administration of the regulatory provisions of the Atomic Energy Act of 1954, nor in any way impede progress in the application of nuclear energy to peacetime purposes in accordance with the purposes and intent of that Act. The decision below

is based on the manner in which the Commission handled this particular case, and will not have general significance. Consequently, it is not appropriate for review on certiorari by this Court.

I

THE ATOMIC ENERGY COMMISSION VIOLATED THE ATOMIC ENERGY ACT OF 1954 BY ISSUING A PERMIT FOR CONSTRUCTION OF AN ATOMIC ENERGY POWER REACTOR WITHOUT FINDING THAT THERE WAS INFORMATION SUFFICIENT TO PROVIDE REASONABLE ASSURANCE THAT THE REACTOR COULD BE CONSTRUCTED AND OPERATED AT THE PROPOSED SITE WITHOUT UNDUE RISK TO THE HEALTH AND SAFETY OF THE PUBLIC.

Petitioners assert that the court below holds that the Commission may not authorize construction of a reactor without first making the same final, definitive and complete findings on the safety of reactor design and operation as are required for the issuance of a license to operate. The court does not so hold.

The issue decided by the court was specifically framed by the Commission itself—and then ignored in the latter's decision. The Commission declared in its Final Decision that "The principal factual issue in this proceeding is whether there is information sufficient to provide a reasonable assurance that a utilization facility of the general type proposed in the PRDC application can be constructed and operated at the location proposed therein without undue risk to the health and safety of the public." (App. B 50; Tr. 6971) At the very outset of the case the Commission itself specified that issue. (Tr. 6359)

What the court correctly held to be fatally defective was the Commission's failure to make a finding, at least a reasonably clear finding, as to *any* assurance, at the time of

the issuance of the construction permit, that the reactor can be operated at the proposed site without undue risk to the health and safety of the public.

The Petitioners assert that the Commission has consistently followed the same policy since the commencement of the reactor licensing program in 1955 as it did in this matter. This is contrary to fact. *The Commission has never failed, in acting on any other application for a construction permit for a power reactor or research and development reactor, either before or after the PRDC permit was issued, to make the finding on safety which the court has held to be necessary.* See Appendix hereto, previously presented to the lower court, listing all construction permits for power reactors, and research and development reactors, issued up to July 1960. The Petitioners have not challenged a single item in this Appendix. Nevertheless, Petitioners assert that every one of the nine power reactors thus far licensed by the Commission has been issued a provisional construction permit with similar findings of reasonable assurance of safety as in this case. That is contrary to the facts, as reference to the decisions in these cases will show. In every one of them, other than the PRDC reactor, the Commission made the kind of finding of reasonable assurance of safety of *operation* which the court deemed essential.

Petitioners lay great weight on a purported distinction between a reactor "of the general type proposed," as used in the Commission's regulation, and a specific reactor for which an applicant seeks a permit. This distinction is specious. Neither the quoted phrase, nor anything similar to it, appears in the Act. The Commission itself made no such distinction in its examination of the PRDC application. The evidence presented on safety related to the specific reactor proposed. The findings of the Commission relating to safety deal with the problems presented

by the proposed PRDC reactor, not fast breeder reactors in general. The court below correctly ignored the distinction insisted upon by Petitioners.

The Commission has clearly not followed its own applicable regulation. Section 50.35 of the Commission's regulations provides that a construction permit may be issued, if all the necessary technical information is not then available, only

". . . if the Commission is satisfied that it has information sufficient to provide reasonable assurance that a facility of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public . . ."

That finding was not made. Petitioners assert that the court has invalidated the Commission regulation under which the construction permit in this case was issued. There is not a word in this decision to that effect, nor may it be reasonably so construed. The court did reject the Commission's rationalization for failing to make the finding which its own regulation requires.

On December 10, 1958, in its Initial Decision, the Commission made an unqualified finding of reasonable assurance of safety of operation (App. B 48; Tr. 6881). On May 20, 1959, in its Final Decision, it modified that finding with the proviso that it was "for the purpose of a provisional construction permit." This nullified, in effect, any assurance as to safety of operation, an assurance called for without any proviso (1) by the Commission's specification of the issue for this case; (2) by the Commission's regulation 50.35, and (3) by the Act, particularly Section 182 which requires, before either a construction permit or an operating license is issued, that the Commission "find that the *utilization or production* of special nuclear material . . . *will* provide adequate protection to the health and safety of the public (Emphasis added) (Pet. No. 315, p. 60).

Against the background of the Commission's consistent practice of making an unqualified finding of reasonable assurance of operating safety at the time it issues a construction permit, the Commission's change of position between its Initial Decision and Final Decision is of decisive significance. *Petitioners make no attempt to deal with it.*

Petitioners seek to defend the Commission's action by contending (1) the Act does not require *any* specific findings at the construction permit stage; (2) a requirement of a definite safety finding at the construction permit stage would, at best, considerably delay private development of atomic energy; (3) nothing in the Act or its legislative history requires or justifies the court's invalidation of the Commission's carefully devised regulating scheme; and (4) the court below overstepped the bounds of judicial review.

There is no merit in any of these contentions.

The court below carefully examined the applicable statutory provisions and came to the inescapable conclusion that the Act does require, at the construction permit stage, a finding the reactor will operate safely. Section 182 specifically makes this requirement for operating licenses. Section 185 equates construction permits with licenses for all purposes other than those specified in that Section, none of which relates to findings at the time the construction permit is issued. If there is any doubt on this score, it is completely removed by the legislative history on this point, quoted at length by the court, which includes a positive affirmation by the chairman of the Committee handling the legislation that "the revised sections on judicial review and on hearings *and on revised section 182 on license applications all apply directly to construction permits.*" (App. B pp. 46, 47.)

PRDC insists, but is apparently not supported in this by the Government, that the legislative history demon-

strates that Congress deliberately rejected the principle that the basic safety determination should be made at the time the construction permit is issued. There is nothing whatever in the legislative history which supports this contention, and PRDC has cited none. On the contrary, during the hearings before the Joint Committee on Atomic Energy on the bill which became the Act, the Chairman specifically assured a witness that if a reactor was constructed in accordance with the requirements of the construction permit, an operating license would be granted.[4] The extent of the Commission's discretion with respect to denial of an operating license is therefore quite limited. Petitioners interpret this colloquy as applying only to hearings and judicial review but fail to cite a single reference which controverts the language quoted above. PRDC recognizes this in making the further argument that the court below erred in requiring a "definitive" finding of safety of operation, as distinguished from a finding in the words of the Commission's regulation Section 50.35. But the court clearly indicated that it would have approved a finding made in these words, as shown by its favorable reference to the Initial Decision of December 10, 1958, which did use those words (App. B. p. 48). However, the Commission deliberately chose not to use that finding in its Final Decision.

Petitioners' contention that the court's holding will delay and interfere with the development of atomic energy is completely untenable, particularly in light of the fact that all other construction permits issued by the Commission for power reactors and research and development reactors do contain the finding deemed essential by the court. This conduct establishes, far more persuasively than the decision of the Commission in this case, how the

[4] Legislative History of Atomic Energy Act of 1954, Vol. II, pp. 1752, 1753.

Commission in fact interpreted the Act. It follows that PRDC's contention that the court invalidated the "carefully devised regulatory scheme" established by the Commission is wholly unwarranted. The court merely invalidated the *Commission's* effort to *bypass* that scheme *in this case*. To permit that would be tantamount to concluding that the Commission had unbridled discretion. But Congress will not be deemed to have delegated unbridled discretion to an agency—even when it placed no express limit on the discretion allowed. *Kent* v. *Dulles*, 375 U.S. 116. There can be no doubt that regulations consistent with the statutes under which they are adopted are binding on the agency. *Accardi* v. *Shaughnessy*, 347 U.S. 260; *Vitarelli* v. *Seaton*, 359 U.S. 535; *Service* v. *Dulles*, 354 U.S. 363.

It is equally free from doubt that an agency's regulations must be consistent with the statute under which they are promulgated, otherwise they are invalid, *Kent* v. *Dulles*, *supra*; *Addison* v. *Holly-Hill Co.*, 322 U.S. 607; *Manhattan General Equipment Co.* v. *C.I.R.*, 297 U.S 129, 134.

Finally, Petitioners assert that the decision of the Commission is in accord with its uniform and settled practice over a period of years, which was repeatedly brought to the attention of Congress but not dealt with in subsequent amendments. This statement is not in accord with the facts. As shown above, the Commission's decision does not follow the uniform practice of the Commission. Furthermore, the references cited in the Commission's decision (Tr. 6958-65) to show that it had apprised Congress of its regulations, in fact show that at no point did Commission representatives say that a construction permit would be issued in the absence of assurance, at the time of issuance of the permit, that the reactor could be constructed and operated without undue risk to the health

and safety of the public. At the time of that testimony the regulations had not yet been adopted or applied.

Significantly, when the Commission went to Congress for an appropriation to carry out its research obligations in connection with this reactor, a substantial conflict developed both in the Joint Committee on Atomic Energy and on the floor of Congress. The money requested by the Commission to carry out its contractual commitments was denied, and specific reference was made to the objections which had been made to the issuance of the permit.[5]

More recently, the Commission advised Congress that, in fact, *its current regulations do require a finding at the time a construction permit is issued that there is reasonable assurance of safe operation.* However, the Commission now believes this requirement too onerous and therefore proposes to amend its regulations to omit it.[6] The proposed amended regulation was published in 25 Fed. Reg. 1224.

The fact that its administration of the Act persuaded the Commission that its previous interpretation is not now practicable does not validate a proposal that is not authorized by the Act. "Administration may reveal gaps or inadequacies of one sort or another that may call for amendatory legislation. But it is no warrant for extending a statute that experience may disclose should have been made more comprehensive." *Addison* v. *Holly Hill Fruit Products, Inc.* 322 U.S. 607, 617.

Safety of the Site. Petitioners assert that the court

[5] Hearings before Senate Committee on Appropriations, 85th Congress, First Session, Atomic Energy Commission Appropriations Bill, H.R. 9379, August 21, 1957, p. 10. Conference Report on H.R. 9379, August 23, 1957, p. 2.

[6] Hearings on Development, Growth and State of the Atomic Energy Industry before Joint Committee on Atomic Energy, 86th Congress, Second Session, pp. 103, 104, 105, February 17, 1960.

below required "compelling reasons" to support the location of reactors near population centers, and thereby usurped the Commission's function and frustrated its administration of the Act. This is a distortion of the court's opinion.

After pointing out the horrendous consequences of an accidental release of fission products from a nuclear reactor, the court quoted the Commission finding that: ". . . Although the data (relating to site suitability) are not yet complete or conclusive, the record gives reasonable assurance that *safe operation of the reactor will be as likely in that location as in any other location.*" (Emphasis added) (App. B 52).

The court held this finding "clearly insufficient". It also stated: "*We need not consider* whether even the most compelling reasons for preferring this location could support a finding that the reactor could be operated at this location without 'undue' risk, or with 'adquate' protection, to the health and safety of the public." (Emphasis added) (App. B 52)

In other words, there is no need to consider whether there are compelling reasons for the present location of this reactor, because the Commission failed to make the safety findings which the Act requires for all reactors; even the *most compelling reasons* for selecting a given location *cannot substitute for the necessary safety findings.*

Petitioners have completely misconstrued the statements of the court below relating to the site of the PRDC reactor. There is no basis whatever for the contention that the court considered the population distribution around the site to be a disqualifying factor in any degree, let alone "the single disqualifying factor" as PRDC asserts (Pet. No. 315, p. 27). Nor is there any basis for the assertion that the decision directs the Commission not to locate any

power reactor in the absence of compelling reasons in an area of population directly comparable to that found here.

While the Court did declare that Congress intended no reactor should, without compelling reasons, be located where it will expose so large a population (over 2 million) to the possibility of a nuclear disaster, *this was not a holding, and was not a factor in the decision.* While there is legislative history supporting the court's statement, this does not enter into the court's interpretation of the Act or its determination of the sufficiency of the Commission's safety findings. The court made this abundantly clear when it added that the most compelling reasons could not make up for the absence of a finding that the reactor could be operated at this location without undue risk to the health and safety of the public.

Finally, as shown above, the Commission did make, with respect to all construction permits for power reactors issued under the Act, with the exception of the PRDC reactor, a specific finding that there was reasonable assurance that the reactor could be constructed and operated *at the proposed location* without undue risk to the health and safety of the public.

Respondents submit that there is nothing novel in the principles which the court has applied to the interpretation of the Act, that there is no conflict between this decision and other cases in this Circuit on the application of those principles, and that the decision does not create any hindrance to the development of the atomic energy industry.

II

THE COMMISSION'S FINDINGS REGARDING THE SAFETY OF OPERATION OF THE PROPOSED REACTOR ARE AMBIGUOUS AND, THEREFORE, DEFICIENT.

The court below carefully reviewed the findings of the Commission with respect to the safety of operation of the proposed reactor and found considerable confusion. It found that various statements on the matter of safety of operation were not consistent with one another. On the one hand, the Commission's principal finding was qualified by the assertion that it found reasonable assurance of operating safety only for the purposes of this provisional construction permit. (App. B p. 48). The court cited a number of other statements made by the Commission confirming the impression that it no longer found, as it had found in December 1958, reasonable assurance that a reactor can be operated at the proposed location without undue risk. (App. B 49-50).

The court pointed out, on the other hand, that the Commission also made several statements which might seem to indicate a positive opinion regarding safety of operation. (App. B 50-51).

The court concluded that the findings regarding safety of operation are ambiguous. In its opinion, the nature, size and location of the project required that the findings be uncommonly free from ambiguity. The court held, consequently, that since the basis of the Commission's action was not reasonably clear, the safety findings are deficient, citing *Secretary of Agriculture* v. *United States*, 347 U.S. 645, 654; *Pacific Far East Line, Inc.* v. *Federal Maritime Board*, 275 F.2d 184, 187; and *Radio Station KFH Co.* v. *Federal Communications Commission*, 101 U.S. App. D.C. 164, 166; 247 F.2d 570, 572. See also

Eastern Central Motor Carriers Association v. *United States*, 321 U.S. 194, 211; *United States* v. *Chicago, Milwaukee, St. Paul Railroad Company*, 294 U.S. 499, 510.

This principle is well established and has been repeatedly applied by this Court, as well as by the court below, and there are no conflicting decisions among the various circuits.

Significantly, the PRDC petition for a writ is silent on this aspect of the court's decision, and fails to mention or consider any of the authorities on which it rests.

The Government does mention this holding of the court and asserts that it is erroneous, but does not argue the point in its petition (No. 454, fn. p. 2[20-21).

Inasmuch as the ambiguity pointed out by the court is sufficient justification in itself for remanding this case to the Commission, the failure of the Petitioners to argue the point requires dismissal of their petitions herein.

III

THE ORDER OF THE COMMISSION IS A FINAL ORDER WHICH ADVERSELY AFFECTS AND AGGRIEVES RESPONDENTS.

Section 189(a) of the Act provides that "In any proceeding under this Act for the granting . . . of any license or construction permit, the Commission shall grant a hearing upon the request of any person whose interest may be affected by the proceeding and shall admit any such person as a party to such proceeding."

Section 189(b) states that "Any final order entered in *any proceeding of the kind* specified in subsection (a) of this section shall be subject to judicial review . . ." (Emphasis added)

The Act clearly provides, therefore, that orders granting construction permits may be final orders. So much PRDC concedes. (Pet. No. 315, p. 34)

Petitioners contend, however, that because further hearing is required before an operating permit will be granted, the order in this case is not final. The Act contemplates, however, that *every* construction permit shall be conditional, and subject to a hearing before an operating permit is issued. Section 185 of the Act provides that after construction of any facility is completed, a license to operate may be granted only upon a finding that the facility has been constructed and will operate in conformity with the application, the law, and the regulations of the Commission, and in the absence of any good cause being shown why the granting of a license would not be in accordance with the provisions of the Act. (App. B 62)

These conditions inhere in the grant of every construction permit. Since the Act provides that orders concerning construction permits may be subject to judicial review, it was certainly not contemplated that review should be denied because a grant is conditional. The legislative history is clear that the issuance of construction permits should be subject to judicial review.[7] It is settled, of course, that the form of an order does not determine its reviewability. *Federal Communications Commission* v. *Columbia Broadcasting System*, 316 U.S. 407.

There are a number of unacceptable conditions in the Commission's Final Decision, Order, and Permit, including the underlying condition that construction would proceed without essential findings concerning health and safety, but with a finding that the site selected is suitable. (Finding 32, Tr. 7023) No change is possible now with respect to the site. The choice is final.

In any event, the court below pointed out that the Commission did, in fact, make it clear that an operating license will be issued when construction is completed, in the state-

[7] Legislative History of Atomic Energy Act of 1954, Vol. III, p. 3759.

ment that "There is reasonable assurance that theoretical and experimental programs under way will develop sufficient data to justify the issuance of an operating license, and that the results of these programs will be available prior to the time it is necessary for the Commission to rule on the operating aspect of the PRDC license Application." (App. B 45)

The validity of the court's conclusion becomes particularly apparent in light of the fact that *there is not a single instance on record of the Commission's refusing to issue an operating license, for any kind of reactor, after construction has been completed.* Construction has been completed on 19 reactors, and operating licenses have been issued for all of them.

PRDC appears to take the position that Respondents would have no standing to sue unless they were affected by the *actual operation of the reactor.* (Pet. No. 315, p. 34, fn. 23) In other words, the Commission's grant of a license to operate would not be appealable, and Respondents would have no remedy until a disaster occurred! Such an interpretation makes a mockery of the right of right of judicial review. Congress could never have intended such an absurdity. The Government does not take this position.

The adverse effect on Respondents of the Commission's action has already been established. In their petitions for intervention before the Commission, Respondents alleged, inter alia, that the action of the Commission would imperil the health and lives of thousands of Respondents' members, would imperil their homes and property, would imperil the plants in which they work and earn their livelihood, would depress the value of their real estate, and would influence their employers to leave the areas which might be affected by an atomic catastrophe.

These allegations were not controverted by PRDC or

by the Commission, and the Commission so stated (Tr. 6362). Having failed to take timely issue on the matter of Respondent's interest, the Petitioner's present contentions in regard thereto must be rejected. *National Coal Association* v. *Federal Power Commission*, 89 App. D.C. 135, 137; 191 F.2d 462, 466.

In a patent effort to confuse the issues, PRDC asserts that the essence of the court's holding on *aggrievement* is found in the tenet that the issuance of the construction permit will result in pressure to approve an operating license because of the great sums of money invested. This is literally an argument *in extremis*, since it is obvious that the opinion of the court below, in regard to Respondents' standing to sue, makes no reference whatever to this so-called "tenet". (App. B 43-45). The Government does not support this position.

The court relied on *Federal Communications Commission* v. *Sanders Brothers Radio Station*, 309 U.S. 470, 477. It is noteworthy that Petitioners make no effort to distinguish this landmark decision; they ignore it. That case, like the present case, involved the issuance of a construction permit. Under the law as it existed at that time, the applicant, after completing construction of a radio station, returned to the Federal Communications Commission for an operating license, and was granted such license only if the conditions of the permit were complied with and no intervening circumstances had arisen that justified denial of an operating license. The fact that the Commission might refuse to grant the operating license did not render the aggrievement speculative so as to deprive the appellant of his standing to sue.

PRDC asserts, but is not supported in this by the Government, that "the only interest which the respondents here are entitled to protect" is the safety of their members from *unreasonable* hazard from the operation of the

reactor. This is flatly contrary to the holding of *Sanders*. The court there declared, p. 476:

> ". . . It does not follow that, because the licensee of a station cannot resist the grant of a license to another, on the ground that the resulting competition may work economic injury to him, he has no standing to appeal from an order of the Commission granting the application . . .
>
> "Section 402(b) of the Act provides for an appeal to the Court of Appeals of the District of Columbia (1) by an applicant for a license or permit, or (2) by any other person aggrieved or whose interests are adversely affected by a decision of the Commission granting or refusing any such application . . .
>
> "Congress had some purpose in enacting Section 402(b)(2). It may have been of the opinion that one likely to be financially injured by the issue of a license would be the only person having a sufficient interest to bring to the attention of the appellate court errors of law in the action of the Commission in granting the license. It is within the power of Congress to confer such standing to prosecute an appeal.
>
> "We hold, therefore, that the respondent had the requisite standing to appeal and to raise, in the court below, any relevant question of law in respect to the order for the Commission."

The reasoning of *Sanders* was relied upon by this Court in *United States* v. *Storer Broadcasting Co.*, 351 U.S. 192, 198. See also *Ashbacker Radio Co.* v. *Federal Communications Commission*, 326 U.S. 327, 331, 332; *Scripps-Howard Radio, Inc.* v. *Federal Communications Commission*, 316 U.S. 4, 14; *Joint Anti-Fascist Refugee Committee* v. *McGrath*, 341 U.S. 123, 151, 156.

The cited cases are dispositive of the issue of the Respondents' standing to sue. None of this Court's decisions cited by petitioners modify or qualify the decisions cited above.

There is no conflict between the decision of the court below in this case, and other decisions of that court. PRDC discusses the authorities on aggrievement without regard to their pertinence to the statute involved in this case. It ignores the fact that Section 10 (a) of the Administrative Procedures Act, as amended, 60 Stat. 245, 5 USC Section 1009, provides that any person adversely affected or aggrieved by agency action "within the meaning of any relevant statute" shall be entitled to judicial review of such action. The meaning and purpose of the relevant statutes involved determine the scope of the right of appeal. *U. S.* v. *Public Utilities Commission, etc.*, 80 App. D.C. 227, 230; 151 F.2d 609, 612; *National Coal Association* v. *Federal Power Commission*, 89 App. D.C. 135, 137; 191 F.2d 462, 466; *Pollak* v. *Public Utilities Commission*, 89 App. D.C. 94, 97, 191 F.2d 450, 453, 456. *Elm City Broadcasting Co.* v. *F.C.C.*, 235 F.2d 811, 815; 98 App. D.C. 314, 318.

Other circuits have taken the same position: *Reade* v. *Ewing*, 205 F.2d 630, 632 (C.A. 2); *Grace Line* v. *Panama Canal Co.*, 243 F. 2d 844, 856 (C.A. 2); *Land O'Lakes Creamery* v. *McNutt*, 132 F.2d 653, 658 (C.A. 8).

PRDC seeks, but is not supported in this by the Government, to draw a distinction between the panel of the court below that decided this case, and other panels of the same court, with respect to the issue of standing to sue. It should be noted that the decision of the court below was considered by the court en banc on a petition for rehearing, and rehearing was denied. Chief Judge Prettyman and Judge Danaher, who voted with the majority in denying the petitions for rehearing, participated in the other cases

in this circuit cited by PRDC for the proposition that there is conflict within the circuit.

None of the cases cited by Petitioners, in support of their contention that the order of the Commission is not a final order which aggrieves the Respondent, is pertinent. None of them deals with a set of circumstances remotely similar to the situation in the case at bar.

Conclusion

It is submitted that, in the light of the principles established by this Court, the statute involved, and particular facts of this case, there is no conflict between the decision of the court below and the decisions of this Court and those of other circuits. The decision does not in any respect frustrate the administration of the regulatory provisions of the Atomic Energy Act of 1954, nor in any way impede progress in the application of nuclear energy to peaceful purposes in accordance with the purposes and intent of the Act. Finally, the decision does not present any important question of federal law which has not been, but should be, settled by this Court.

For the foregoing reasons, the petitions for a writ of certiorari should be denied.

Respectfully submitted,

BENJAMIN C. SIGAL,
1126 16th Street, N.W.,
Washington 6, D. C.
Attorney for Respondents.

Of Counsel:

HAROLD CRANEFIELD,
LOWELL GOERLICH.

OCTOBER, 1960.

APPENDIX

Construction Permits Issued by Atomic Energy Commission

I. *Power Reactors*

CPPR-1	Consolidated Edison Co.	21 F.R. 3084—	5/ 9/5
CPPR-2	Commonwealth Edison Co.	21 F.R. 3085—	5/ 9/5
CPPR-3	General Electric Company	21 F.R. 3395—	5/22/5
CPPR-4	*Power Reactor Development Co.*	21 F.R. 5974—	8/ 9/5
CPPR-5	Yankee Atomic Electric Co. [1]	22 F.R. 7188	
		22 F.R. 9237—	11/19/5
CPPR-6	Saxton Nuclear Experimental Corp.	24 F.R. 9244	
	Associates, Inc.	25 F.R. 1471 —	2/18/6
CPPR-7	Carolinas Virginia Nuclear Power	25 F.R. 522	
	Associates, Inc.	25 F.R. 4206—	5/11/6
CPPR-8	Northern States Power Company	25 F.R. 254	
		25 F.R. 4484—	5/20/6
CPPR-9	Consumers Power Company	25 F.R. 1699	
		25 F.R. 5002—	6/ 7/6

II. *Research and Development Reactors*

CPRR-1	University of Michigan [2]		2/17/5
CPRR-2	Armour Research Foundation [2]		6/12/5
CPRR-3	U.S. Naval Research Lab. [2]		4/29/5
CPRR-4	Battelle Memorial Institute [2]		5/ 4/5
CPRR-5	Massachusetts Institute of Technology [2]		5/ 7/5
CPRR-6	Aerojet-General Nucleonics	21 F.R. 6520—	8/29/5
CPRR-7	Industrial Reactor Lab. Inc.	22 F.R. 618—	1/30/5
CPRR-8	Westinghouse Electric Corp.	22 F.R. 152	
		22 F.R. 4891—	7/11/5
CPRR-9	Aerojet-General Nucleonics	22 F.R. 742	
		22 F.R. 1321—	3/ 2/5
CPRR-10	North Carolina State College	22 F.R. 1052	
		22 F.R. 1616—	3/13/5
CPRR-11	Curtiss Wright Corp.	22 F.R. 3902	
		22 F.R. 4516—	6/27/5
CPRR-12	Aerojet-General Nucleonics	22 F.R. 4327	
		22 F.R. 4919—	7/12/5
CPRR-13	Aerojet-General Corp. & Aerojet Gen. Nucl.	22 F.R. 4329	
		22 F.R. 4919—	7/12/5
CPRR-14	North American Aviation, Inc.	22 F.R. 5648	
		22 F.R. 6367—	8/ 8/5

[1] Where there are two F. R. citations for an application, the first contains the notice of intention to issue a construction permit, generally including all findings of fact, and the second contains notice of issuance of permit. Dates given are dates of publication of notice of issuance of permit.

[2] Not published in Federal Register. Date given is date of issuance of permit.

CPRR-15	Univer[illegible] of Virginia	22 F.R. 6978
CPRR-16	Ordnance Materials Research Office	22 F.R. 7494— 9/19/57 22 F.R. 7410
CPRR-17	Daystrom, Inc.	22 F.R. 8020—10/ 9/57 22 F.R. 7667
CPRR-18	Union Carbide Corp.	22 F.R. 8424—10/25/57 22 F.R. 7916
CPRR-19	General Electric Co.	22 F.R. 9005—11/ 9/57 22 F.R. 8019
CPRR-20	American Radiator and Standard Sanitary Corp.	22 F.R. 8855—11/ 2/57 22 F.R. 8189
CPRR-21	University of Florida	22 F.R. 8964—11/ 7/57 22 F.R. 9732
CPRR-22	Aerojet-General Nucleonics	22 F.R. 20— 1/ 1/58 23 F.R. 168
CPRR-23	Aerojet-General Nucleonics	23 F.R. 690— 2/ 1/58 23 F.R. 689
CPRR-24	Aerojet-General Nucleonics	23 F.R. 1279— 3/ 1/58 23 F.R. 725
CPRR-25	General Dynamics Corp.	23 F.R. 1279— 3/ 1/58 23 F.R. 2462
CPRR-26	North American Aviation, Inc.	23 F.R. 3107— 5/ 9/58 23 F.R. 2991
CPRR-27	Aerojet-General Nucleonics	23 F.R. 3581— 5/23/58 23 F.R. 5551
CPRR-28	Babcock and Wilcox Co.	23 F.R. 6189— 8/12/58 23 F.R. 6380
CPRR-29	Nuclear Development Corp. of Amer.	23 F.R. 7089— 9/12/58 23 F.R. 7332
CPRR-30	University of Arizona	23 F.R. 7934—10/14/58 23 F.R. 8681
CPRR-31	Cornell University	23 F.R. 9270—11/29/58 23 F.R. 8681
CPRR-32	North Carolina State College	23 F.R. 9270—11/29/58 23 F.R. 8769
CPRR-33	University of Wyoming	23 F.R. 9355—12/ 3/58 24 F.R. 951
CPRR-34	North Carolina State College	24 F.R. 1664— 3/ 5/59 24 F.R. 1575
CPRR-35	West Virginia University	24 F.R. 2317— 3/25/59 24 F.R. 4569
CPRR-36	Veterans Administration Hospital	24 F.R. 5255— 6/27/59 24 F.R. 4671
CPRR-37	State College of Washington	24 F.R. 5347— 7/ 1/59 24 F.R. 5121
CPRR-38	Texas Agricultural and Mechanical College Sys.	24 F.R. 5696— 7/15/59 24 F.R. 5744
CPRR-39	University of Buffalo	24 F.R. 6441— 8/11/59 24 F.R. 7045
		24 F.R. 7625— 9/22/59

CPRR-40	University of Washington	24 F.R. 7797
		24 F.R. 8469—10/20/59
CPRR-41	Iowa State University	24 F.R. 7741
		24 F.R. 8468—10/20/59
CPRR-42	University of California	24 F.R. 8468
		24 F.R. 9409—11/21/59
CPRR-43	Virginia Polytechnic Institute	24 F.R. 8660
		24 F.R. 9409—11/21/59
CPRR-44	Curators of University of Missouri, School of Mines and Metallurgy	24 F.R. 9028
		24 F.R. 9556—11/28/59
CPRR-45	Worcester Polytechnic Institute	24 F.R. 9064
		24 F.R. 9590—12/ 1/59
CPRR-46	Board of Trustees of Leland Stanford Junior University	24 F.R. 9027
		24 F.R. 9556—11/28/59
CPRR-47	Naval Research Laboratory	24 F.R. 9027
		24 F.R. 9557—11/28/59
CPRR-48	Walter Reed Army Institute of Research	24 F.R. 10322
		24 F.R. 255— 1/13/60
CPRR-49	Ohio State University	25 F.R. 415
		25 F.R. 1140— 2/ 9/60
CPRR-50	American Radiator and Standard Sanitary Corp.	25 F.R. 1968— 3/ 5/60
CPRR-51	University of Illinois	25 F.R. 2369
		25 F.R. 3148— 4/12/60
CPRR-52	University of Kansas	25 F.R. 2465
		25 F.R. 3200— 4/13/60
CPRR-53	University of Maryland	25 F.R. 5253
		25 F.R. 6374— 7/ 7/60
CPRR-54	Atomic International, Division of North American Aviation, Inc.	25 F.R. 5192
		25 F.R. 6373— 7/ 7/60
CPRR-55	University of Wisconsin	25 F.R. 4206
		25 F.R. 5253— 6/11/60
CPRR-56	Lockheed Aircraft Corp.	25 F.R. 4701
		25 F.R. 5549— 6/18/60
CPRR-57	Georgia Institute of Technology	25 F.R. 4700
		25 F.R. 5549— 6/18/60
CPRR-58	Cornell University	25 F.R. 5191
		25 F.R. 6372— 7/ 7/60

No. 315

JAMES R. BROWNING, Clerk

Supreme Court of the United States

OCTOBER TERM, 1960

POWER REACTOR DEVELOPMENT COMPANY, *Petitioner*,

v.

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL-CIO, *et al.*, *Respondents*

ON PETITION FOR A WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

REPLY MEMORANDUM FOR PETITIONER

JOHN LOGIE O'BRIAN,
W. GRAHAM CLAYTOR, JR.,
701 Union Trust Building,
Washington 5, D.C.

EDWARD S. [illegible], JR.,
RICHARD B. [illegible],
2436 Penobscot Building,
Detroit 26, Michigan,

Attorneys for Petitioner,
Power Reactor Development Company

[illegible] & BUELING,
Washington, D. C.,

MILLER, CANFIELD, PADDOCK AND STONE,
Detroit, Michigan,

Of Counsel

NOVEMBER 2, 1960

Supreme Court of the United States

OCTOBER TERM, 1960

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REPLY MEMORANDUM FOR PETITIONER

I

Respondents suggest that the decision below presents no question of importance because all the Court of Appeals held was that the Atomic Energy Commission did not make adequately definitive safety findings as required not only by the statute but also by its own Regulations and specification of issues. They also dispute that the effect of the decision is to invalidate a regulation or to upset the Commission's settled practice in reactor licensing cases. In effect, what they now urge to this Court is that the Commission has, uniquely in this case, misapplied the statute and its regulations by failing to find *any* assurance of safety of either the particular reactor or of the gen-

eral type of reactor proposed (p. 11), and that the correction of this error by the decision below raises no question of general importance in the administration of the act. These contentions are plainly unsound.

The crux of the issue here is the validity under the statute of the basic premise on which the Commission's provisional construction permit scheme embodied in Section 50.35 of its Regulations is based. This premise is that a different standard of "reasonable assurance" is required for issuance of a construction permit "on a provisional basis" under this Regulation from that which is required to support subsequent issuance of an operating license. Although Respondents suggest (p. 11) that the decision below does not require a finding of the same assurance at these two stages, the court's opinion is clear that such a holding was the basis upon which its reversal of the Commission's order rested. As set out in our Petition (p. 14), after summarizing the safety finding required to be made by the Commission to support issuance of an operating license, the court said (App. B, p. 45):

> "The question is whether it must make such a finding when it authorizes construction. In our opinion it must."

Section 50.35 of the Regulations sets up a procedure, followed in all power reactor licensing cases thus far presented,[1] pursuant to which a provisional construc-

[1] Respondents repeatedly state (pp. 10, 12, 16, 19) that the provisional construction permit issued here is the only one in which the Commission did not make the safety findings required by the statute, and that, in short, this is a unique case which stands apart from the other eight developmental power reactors and the almost sixty research reactors listed in the appendix to Respondents' brief (pp. 28-30). This is not so. Every one of the other eight power

tion permit is issued on a finding of "reasonable assurance" of the safety of the "general type" of reactor proposed. The whole purpose of this provision is to permit construction of such a reactor to be started in appropriate cases in the absence of all the technical information that would be required to support a definitive finding that the reactor when completed can be operated safely. As the Commission stated in its opinion (Tr. 6983), this approach is dictated by the technological characteristics of reactor design at this stage of development of the art. See our Petition, pp. 17-19.

The keystone of the regulatory structure established by this provision of the Regulations is thus that different standards of assurance are to be required at these two stages of the licensing process. The Commission's opinion was unmistakably explicit on this point:

> "The degree of 'reasonable assurance' with respect to safety that satisfies us in this case for purposes of the *provisional* construction permit would not be the same as we would require in considering

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reactors, and most of the smaller research reactors as well, were issued provisional construction permits upon the finding required by Section 50.35 of the Regulations of "reasonable assurance that a facility *of the general type proposed* can be constructed and operated at the proposed location without undue risk to the health and safety of the public" (italics supplied). As the Commission made clear in its opinion here, this Section 50.35 finding necessarily encompasses a lesser degree of assurance of safety than is required to support an operating license. The fact that this was not articulated in these other cases to the extent it was here is attributable not to any difference in the substantive findings made or quantum of proof required, but to the fact that none of the other cases was contested and there was accordingly no reason for such discussion.

"the issuance of the *operating* license" (A.E.C. Opinion, Tr. 6987).

If this basic concept is accepted, it is plain that the Commission's findings with respect to assurance of safety were fully adequate. Finding 22 stated, in the precise words of both Section 50.35 of the Regulations and of the principal issue specified by the Commission for determination at the hearing (Tr. 7020), that

> "The Commission finds reasonable assurance in the record, for the purposes of this provisional construction permit, that a utilization facility of the general type proposed in the PRDC Application and amendments thereto can be constructed and operated at the location without undue risk to the health and safety of the public."

The only objection made to this finding has been that it includes the words "for the purposes of this provisional construction permit." But whether stated or not, the provisional construction permit is always the "purpose" for which a finding under Section 50.35 of the Regulations is made. The issuance of such a permit was the only issue before the Commission, and the inclusion of these words serves only to emphasize the fact, which the Commission independently made perfectly clear in both its initial and its final decision,[2] that the degree of assurance which it found "reason-

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[2] Both the court below (Pet. App. B, p. 48) and Respondents here (pp. 13-14) have emphasized that the Commission in its Initial Decision made an "unqualified" safety finding which it subsequently "qualified" in its Final Decision by adding the proviso that it was "for the purposes of a provisional construction permit". It is plain from the Commission's opinions in both instances, however, that these findings were intended to have the same meaning and that the proviso added was not in any sense considered to be a change of substance.

able" for purposes of a provisional construction permit was not the same degree of assurance which would be "reasonable" to support issuance of an operating license.

In reversing the Commission's construction permit order, the Court of Appeals plainly held that under the statute the Commission has no authority to require a different degree of assurance of safety at these two stages of the regulatory process. It was only because the court rejected this fundamental principle and confused the concepts involved that it thought the Commission's findings were "ambiguous". The alleged ambiguity of the findings was in no sense an independent ground of decision, but followed from the court's rejection of the Commission's basic provisional construction permit scheme. This rejection plainly presents a question of grave importance in the administration of the Atomic Energy Act which calls for review by this Court.

II

With respect to the proposed site of the reactor, Respondents suggest a very restricted interpretation of the opinion below. In their view, the court did not lay down a rule requiring "compelling reasons" for location of any reactors near population centers. On the contrary, Respondents assert that "this was not a holding, and was not a factor in the decision" (p. 19). Indeed, Respondents apparently construe the opinion below as stating only that the site is unsatisfactory for a reactor not adequately determined to be safe; as they put it, "even the *most compelling reasons* for selecting a given location *cannot substitute for the necessary safety findings*" (p. 18).[3]

[3] It is understandable that Respondents would take this position, since neither they nor any one else prior to announcement of the

We hope Respondents are right that the opinion below meant no more than this. On its face, however, it appears to establish a rule for reactor location which is plainly inconsistent with the basic Congressional purpose and which would have drastic impact, as set out more fully in our Petition. The serious implications it would have for the United States nuclear power program emphasize the importance of review of this question by this Court.

III

Respondents seek to minimize the significance of the Court of Appeals' holding on the question of Respondents' standing to review the Commission's construction permit order by now resurrecting an argument that was made to and explicitly rejected by that court. This argument is that construction of the reactor would itself imperil the health of Respondents' members and cause them economic injury (pp. 3 and 23). As the court below pointed out, however, Respondents have conceded that mere construction of the reactor does not involve any danger to Respondents' members or their property (Pet. App. B, p. 44). So much is also obvious from the allegations in Respondents' petitions to intervene before the Commission which, contrary to Respondents' present contentions, explicity asserted that a variety of injuries would result to them from "an explosion or other incident" due to an inherent lack of safety in the *operation* of the reactor to be constructed (*e.g.*, Tr. 6302). Thus, as the court below stated, Respondents' theory of standing necessarily rests on the proposition that "construction

decision below had suggested that the site was unsuitable for a reactor of this size and type, and the Commission made a definitive finding, not attacked on review, that it was so suitable. Finding 32, Tr. 7023; see our Petition, pp. 30-32.

would cause operation, and operation would cause injury, not that construction without operation would cause injury" (Pet. App. B, p. 44).

Respondents, however, now repudiate the argument that issuance of the construction permit results in pressure on the Commission to issue an operating license because of the large sums of money invested, and state emphatically that the court below did not rest its conclusion on any such determination (p. 24). This leaves no conceivable support for the holding of that court that Respondents are aggrieved by the Commission's construction permit order except the obviously untenable theory that, because the Commission has found it probable that PRDC will be able to produce the requisite proof that the reactor can be operated safely, there is a probability that permission so to operate it will eventually be granted (Pet. App. B, p. 45). While PRDC readily agrees that it expects to adduce the requisite proof in the operating license proceedings still to be held, it is undisputed that such license can issue only after a further full hearing in which Respondents will have the right to participate as parties, and after a further decision by the Commission, subject to judicial review, as to whether this prediction of proof of safety has been translated into fact.

Respondents' position here thus boils down to the proposition that, despite the fact that the ultimate question of safety of operation of this reactor is still to be determined in a further formal proceeding, and despite the fact that no contention is now made that the issuance of this construction permit itself will injure Respondents or result in the exertion of pressure on the Commission to reach a favorable decision on this issue in such further proceeding, the mere indicated probability that the required safety showing will be made

and will result in the requested authorization is sufficient to result in aggrievement justifying review of the construction permit order at this time. Nothing in *Federal Communications Commission* v. *Sanders Bros. Radio Station*, 309 U.S. 470, touches upon this situation. For the reasons and under the authorities set forth in our Petition, it is submitted that this extends the scope of judicial review far beyond the principles laid down by this Court and accepted in other circuits. The petition to the court below to review this construction permit order of the Commission should accordingly have been dismissed.

Respectfully submitted,

JOHN LORD O'BRIAN,
W. GRAHAM CLAYTOR, JR.,
701 Union Trust Building,
Washington 5, D. C.

EDWARD S. REID, JR.,
RICHARD B. GUSHEE,
3456 Penobscot Building,
Detroit 26, Michigan.

Attorneys for Petitioner,
Power Reactor Development Company

COVINGTON & BURLING,
Washington, D. C.

MILLER, CANFIELD, PADDOCK AND STONE,
Detroit, Michigan.

Of Counsel

NOVEMBER 2, 1960

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No. 454

In the Supreme Court of the United States

OCTOBER TERM, 1960

UNITED STATES OF AMERICA AND ATOMIC ENERGY COMMISSION, PETITIONERS

v.

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL-CIO, ET AL.

ON PETITION FOR A WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

MEMORANDUM IN REPLY TO RESPONDENTS' BRIEF IN OPPOSITION

J. LEE RANKIN,
Solicitor General,
GEORGE COCHRAN DOUB,
Assistant Attorney General,
MORTON HOLLANDER,
Attorney,
Department of Justice, Washington 25, D.C.

EARL D. NAIDEN,
Acting General Counsel,
CURTS OULAHAN,
Deputy General Counsel,
LIONEL KESTENBAUM,
Attorney,
Atomic Energy Commission, Washington 25, D.C.

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In opposing review, respondent unions contend that the decision of the court of appeals does not have the broad reach that we ascribe to it, but turns upon the particular facts of this case. Specifically, they urge (Br. in Op. 11–14) (1) that the court below did not hold that the Commission must make the same safety findings to authorize construction of a reactor as it must make to authorize operation, but held merely that the Commission did not here make the findings that it has made in granting other construction per-

mits, since it failed to make "a reasonably clear finding, as to *any* assurance" of ultimate operating safety; and (2) that the ruling below that the Commission cannot authorize construction of a nuclear reactor near a populated area without finding "compelling reasons" for such location, was *"not a holding, and was not a factor in the decision"* (Br. in Op. 19, emphasis in original). Neither contention has merit.[1]

1. At the outset of its discussion of "Safety Findings Required by the Atomic Energy Act," the court of appeals posed the issue before it with respect to the kind of safety findings the Commission must make in granting a construction permit as follows (Pet. No. 454 ("Pet."), pp. 35–37, emphasis in original):

> Petitioners contend that "The Act and the regulations of the Commission * * * require, as conditions precedent to the issuance of every construction permit for an atomic energy power reactor, that *as of the time the construction permit is issued* the Commission find that (1) it has reasonable assurance that the reactor may be constructed *and operated* at the proposed site without undue risk to the health and safety of the public * * *."
>
> It is undisputed that the Commission must make such a finding when it authorizes operation. The question is whether it must make such a finding when it authorizes construction. In our opinion it must.

The court's conclusion that the Commission "must" make the *same* safety findings "when it authorizes con-

[1] Respondents' contention (Br. in Op. 21–27) that the court below correctly held that they had standing to maintain this action is, we believe, fully answered in our petition (pp. 28–29).

struction" as it makes "when it authorizes operation" rested primarily upon the court's interpretation of the legislative history of the Atomic Energy Act of 1954 (Pet. 37–39). In the court's view, this history indicated that "the Act * * * require[s], as a condition to the issuance of a construction permit, a finding that the proposed facility can be operated without undue risk to the health and safety of the public" (*id.* at 39). This finding, as the court had already pointed out, is the same finding that the Act requires for the issuance of an operating license. The court thus ruled that the findings which the Commission "must" make "when it authorizes construction" are the same as it "must" make "when it authorizes operation." As we pointed out in our petition (pp. 19–28), this erroneous construction of the Act would seriously impede the government's program for the development of nuclear power reactors.

Respondents attempt to avoid this statutory holding by arguing that although the Commission, in the eight other cases in which it has granted construction permits for developmental power reactors, found that there was reasonable assurance that a reactor of the type proposed could be operated at the particular site without undue risk to public health and safety, it did not make such a finding here. Even if correct, this argument would not meet our point that the decision below enunciates a serious general misconstruction of the statute which should be corrected; in any event, respondents' contention is factually incorrect.

Respondents cannot, and do not, deny that the Commission here made the precise finding required by its

regulation for granting a construction permit, namely, that there was "reasonable assurance"

> that a utilization facility of the general type proposed in the PRDC Application and amendments thereto can be constructed and operated at the location without undue risk to the health and safety of the public [Finding 22, Tr. 7020].

This is the same finding that the Commission made in granting the eight other construction permits for developmental reactors that it has hitherto authorized, as well as those for most research and testing reactors.

The sole basis upon which respondents attempt to distinguish the finding of "reasonable assurance" here from the same finding made in the eight other cases is that here the finding recited that it was made "for the purposes of this provisional construction permit" (Tr. 7020). That recital, however, plainly was not intended to, and did not, derogate in any way from the basic finding, reiterated several times without the recital (Tr. 6971, 6983–6984, 7022–7023), that there was reasonable assurance that a reactor of this general type could be *operated* at this site without undue risk to public health and safety. Its purpose was merely to reemphasize, and to make particularly explicit, in the Commission's first contested reactor construction licensing case, that the grant of the PRDC construction permit was not to be taken as any indication that the safety findings there made would of themselves also justify an operating license. Indeed, whenever the Commission finds, in issuing a construction permit, that there is reasonable assurance that a facility of the type proposed can be operated consistent with the

public health and safety, such finding necessarily is made for the purposes of the particular construction permit involved. Under the express terms of the Commission's regulation, another safety finding relating to the particular reactor's "final design" (as distinguished from "the general type" proposed) will be required before an operating license will be issued. Accordingly, the use in this case of the phrase "for the purposes of this provisional construction permit" merely made explicit what is inherent in every grant of a construction permit—and did nothing more.

2. Although respondents now attempt to minimize the significance of the court of appeals' ruling on "compelling reasons" as neither a "holding" nor "a factor in the decision" (Br. in Op. 19), we believe that the opinion below purports to announce the general rule that the Atomic Energy Act precludes the Commission from locating a reactor near a heavily populated area without "compelling reasons" therefor. After first holding that the Commission's "findings regarding safety of operation are ambiguous" (Pet. 43), the court went on to hold (*ibid.*) that "the Commission's safety findings are deficient in an additional respect." The additional respect in which such findings were "deficient" was that, although "Congress intended no reactor should, without compelling reasons, be located where it will expose so large a population to the possibility of a nuclear disaster[, i]t does not appear that the Commission found compelling reasons or saw that such reasons were necessary" (Pet. 44). After reviewing the Commission's finding with respect to site safety (Pet.

44–45), the court concluded: "We think this finding clearly insufficient" (Pet. 45). The court then went on to say (*ibid.*), by way of dictum: "We need not consider whether even the most compelling reasons for preferring this location could support a finding that the reactor could be operated at this location without 'undue' risk, or with 'adequate' protection, to the health and safety of the public."

On its face, therefore, the court of appeals' opinion enunciated the general rule, which it believed "Congress intended," that the Commission cannot locate a nuclear reactor near a populated area "without compelling reasons." As we demonstrated in our petition (pp. 12–19), engrafting such a requirement on the Atomic Energy Act—a requirement not contained in the statute and, we believe, refuted by the legislative history—would seriously interfere with the Congressional purpose of encouraging and furthering, with due protection to the public health and safety, the development of the peaceful uses of atomic energy.

For the reasons stated in the petition and in this memorandum it is respectfully submitted that the petition for a writ of certiorari should be granted.

J. LEE RANKIN,
Solicitor General.
GEORGE COCHRAN DOUB,
Assistant Attorney General.
MORTON HOLLANDER,
Attorney.

NEIL D. NAIDEN,
Acting General Counsel,
COURTS OULAHAN,
Deputy General Counsel,
LIONEL KESTENBAUM,
Attorney, Atomic Energy Commission.

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ON WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

BRIEF FOR THE PETITIONERS

ARCHIBALD COX,
Solicitor General,
WILLIAM H. ORRICK, JR.,
Assistant Attorney General,
DANIEL M. FRIEDMAN,
Assistant to the Solicitor General,
MORTON HOLLANDER,
Attorney,
Department of Justice, Washington 25, D.C.

WILL D. NAIDEN,
General Counsel,
ROBERTS OULAHAN,
Deputy General Counsel,
DANIEL KESTENBAUM,
Attorney,
Atomic Energy Commission, Washington 25, D.C.

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v.

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BRIEF FOR THE PETITIONERS

OPINION BELOW

The opinion of the Court of Appeals (R. 953–968)[2] is reported at 280 F. 2d 645. The opinion of the Atomic Energy Commission is set forth at R. 630–712.

[1] This case has been consolidated with *Power Reactor Development Company* v. *International Union of Electrical, Radio and Machine Workers, AFL–CIO, et al.*, No. 315, this Term (R. 972–973).

[2] Citations are to the pages of the printed record in this Court consisting of three volumes. In Volumes I and II, such pagination is given at the bottom of each page; the boldfaced references at the top of each page indicate the original pagination of the certified transcript of proceedings before the Atomic Energy Commission, utilized in the court below.

JURISDICTION

The judgment of the court of appeals was entered on June 10, 1960 (R. 969), and petitions for rehearing *en banc* were denied on July 25, 1960 (R. 970-971). The petition for a writ of certiorari was filed on September 29, 1960, and was granted on November 14, 1960 (R. 973; 364 U.S. 889). The jurisdiction of this Court rests upon 5 U.S.C. 1040 and 28 U.S.C. 1254(1).

QUESTIONS PRESENTED

1. Whether the Atomic Energy Act of 1954 requires the Atomic Energy Commission, in granting a permit for the construction of a developmental atomic power reactor, to make the same findings with respect to the safety of its operation as are required before it grants an operating license.

2. Whether the Act precludes the Commission from approving a site for an atomic power reactor that is close to a populated area—based on Commission findings that the site is suitable for a reactor of the general type and that there is reasonable assurance that its operation there would not cause undue risk to the public health and safety—unless the Commission further finds that there are "compelling reasons" for such location.[3]

---

[3] A subsidiary question presented is whether, as the court of appeals held (R. 963), "the Commission's findings regarding safety of operation are ambiguous." See *infra*, pp. 69–70.

STATUTE AND REGULATIONS INVOLVED

The pertinent provisions of the Atomic Energy Act of 1954 and of the Commission's regulations are set forth in Appendix A, *infra*, pp. 91–136.

STATEMENT

This case involves the validity of a permit for the construction of a large developmental atomic power reactor, issued by the Atomic Energy Commission under the Atomic Energy Act of 1954. By a divided vote the court of appeals set aside the construction permit upon the ground that the Commission did not make certain findings which a majority of the court deemed prerequisite to its issuance.

1. ATOMIC REACTORS

The world's first atomic reactor—a device capable of maintaining a controlled fission chain reaction—was the historic Chicago Pile, which commenced operation at Stagg Field on December 2, 1942. Eighteen years later many different types of reactors are being used for a variety of civilian and military purposes—for power, propulsion, research and training, medical therapy, testing and the production of new atomic fuel (*i.e.*, fissionable materials). But the same basic principles—the controlled, self-sustaining nuclear chain reaction—are common to all.[4]

[4] For a discussion of these basic principles in terms helpful to the layman, see the testimony of Professor Hans Bethe at pages 730–779 of the record; Hughes, *On Nuclear Energy;* see also Glasstone, *Source Book on Atomic Energy* (2d ed. 1958).

Nuclear Fission—When a free neutron strikes the nucleus of an atom of uranium (U) in just the right manner, the nucleus flies into fragments—that is to say, a splitting or "fission" occurs—which results in (1) fragments composed of several dozen different elements, nearly all of which are highly radioactive forms of the elements and are therefore called "radioisotopes," (2) energy, and (3) free neutrons.

The total weight of the fragments and free neutrons remaining after fission is less than the weight of the original atom. Mass has been turned into energy according to the famous Einstein equation, $E=mc^2$; in other words, the energy resulting from fission is the amount of mass which is "destroyed," multiplied by the square of the velocity of light. The resulting energy is chiefly the kinetic energy of flying fragments. As they bump into other matter and into each other, the kinetic energy is transformed into heat. One of the central problems in the development of power reactors for industrial use was to find safe and efficient methods of converting this heat into electricity.

Neutron Reproduction.—The fission of the nucleus of an atom releases free neutrons. If one of the neutrons released were invariably to strike the nucleus of another atom in just the right manner to cause fission, there would be a self-sustaining chain reaction lasting as long as the fissionable material. Obviously, this would also be true if one started with 100 nuclear reactions in a mass of fissionable material which released free neutrons exactly 100 of which always

struck new nucleii in just the right manner to cause fission. If the 100 reactions in the first generation produced only 95 reactions in the second and the decline continued, the chain reaction could not sustain itself. On the other hand, if the 100 reactions in the first generation produced 105 reaction-causing neutrons in the second and an additional 5 per cent compounded in each successive generation, then the chain reaction would not only be self-sustaining but the amount of energy released—the "power level"—would increase. Because the lifetime of each generation is very short, the increase at this rate of reproduction would be rapid indeed.

Fission is constantly occurring in natural uranium but the reaction is not self-sustaining because the material susceptible to fission is widely dispersed, hence too many of the neutrons released suffer fates other than striking the nucleus of another fissionable atom. Because we are dealing with very, very large numbers—literally many billions of atoms—the fate of the free neutrons is mathematically predictable; and the predictions can be verified empirically. In this sense their fate is also controllable, within certain limits, by methods presently to be described. It is chiefly by controlling the fate of the free neutrons than man can control the rate of reproduction and thereby create a self-sustaining chain reaction, alter the power level, and keep the reaction under control.

One of the fates which may befall free neutrons released by fission is passing entirely out of the fissionable material (or "fuel") before striking another

nucleus in such a way as to cause another nuclear reaction. These neutrons become irrelevant. Since striking another nucleus in this manner is a matter of chance, the number of neutrons which suffer this fate obviously depends upon the distances they have to travel before they are free of the fuel, in other words, upon the size or volume of the fuel. Atomic scientists speak of the amount which will permit a self-sustaining chain reaction as the "critical size". If the fuel is in lumps, cores, or pins separated from each other, the rate of reproduction will be affected not only by their size and number but also by their shape and arrangement with respect to each other, by the distances between them and by reflecting material surrounding them. Thus, one method of controlling the rate of reproduction, and therefore the power level of a reactor, is to add or subtract fuel or to change its physical arrangement.

A second fate which befalls neutrons freed by fission is their capture by impurities in the fissionable materials. The impurity may be the result of accident as in the case of other elements mixed with uranium ore in its natural state. It may be a necessary part of the apparatus as a whole, even though it reduces its reactivity. It may be a foreign substance introduced into the fuel for the very purpose of capturing free neutrons, thereby reducing the rate of reproduction and lowering the power level. Thus, inserting and withdrawing control rods made of a non-fissionable neutron-absorbing material such as boron is the principal method of controlling a chain reaction.

Still another way of influencing the fate of the neutrons freed by fission is to control their speed. All the neutrons emitted by fission are moving exceedingly fast—8,000 miles per second—but the chance that any single neutron will strike and split the nucleus of another atom is increased, and therefore the rate of reproduction is increased, by retarding the neutrons without capturing them. The substances which serve this purpose are called "moderators." The most useful moderators are made of elements with low atomic weights such as hydrogen and carbon. For example, the moderator in the atomic pile at Stagg Field was a highly refined graphite.

Fissionable Materials for Atomic Fuel.—The rate of neutron reproduction, and therefore the number of nuclear reactions occurring in a reactor, depends upon the fissionability of the fuel. Some atoms split more readily than others. Although the chemist long supposed that each element was uniform when pure, the nuclear physicist demonstrated that a single element may have several forms, called "isotopes". When uranium is in its natural state, there is a total of 238 protons and neutrons in the nucleus of nearly all atoms (U^{238}). A small percentage (about 0.7%) of a uranium isotope which has only 235 protons and neutrons in the atom is also present (U^{235}). U^{238} is much more fissionable than U^{235}. Consequently, if one separates the isotope U^{235} out of refined, natural uranium and then brings the proper quantity together, he may produce a self-sustaining chain reaction with smaller quantities and less difficulty than

with natural uranium. He may also achieve a reproduction rate high enough and fast enough to cause an explosion, if that be his desire.

Breeding.—Since the atomic scientists first worked with natural uranium, a low quality atomic fuel, they were anxious to reduce the capture of free neutrons so as to achieve a rate of neutron reproduction greater than unity, thus making the chain reaction self-sustaining. To cause an explosion a much higher rate of reproduction was required. But the capture of free neutrons may produce highly useful products. Thus, where fission occurs in a quantity of uranium containing both U^{235} and U^{238}, the relatively nonfissionable U^{238} will capture a percentage of the free neutrons. The U^{238}, which is plentiful, is turned into U^{239} by the addition of the captured neutron to its nucleus; it then emits two beta particles and becomes Plutonium (Pu^{239}). Pu^{239} is highly fissionable; it therefore makes an excellent atomic fuel. Its production in a reactor would tend to reduce the net rate of consumption of high-grade fissionable materials, even though the rate of consumption of U^{235} exceeded the rate of production of Pu^{239}. In fact, it has proved feasible to build a reactor in which more Pu^{239} is produced than U^{235} is consumed, thus resulting in a net gain in high-grade fissionable materials. The process is like starting an automobile trip with a quantity of crude petroleum and a half-full gasoline tank and, without buying gas, returning with somewhat less crude oil but the gasoline tank now full. The process is called "breeding". The ability to

breed will be one of the great virtues of the power reactor involved in the present case.

While the use of slow neutrons increases the efficiency of the chain reaction as described above, enabling a reactor to operate with less fuel, it interferes with breeding. Fast neutrons are more efficient for the production of fissionable material, principally because they are not easily captured by other substances. Accordingly, in the present state of the art, whether one employs a moderator depends partly upon his purpose. If his greatest concern is with generating power, he may use a moderator and slow the neutrons. If he wishes to produce fissionable materials more efficiently, he will want fast neutrons to accomplish the breeding. Thus, the description "fast breeder reactor," which is correctly applied to the reactor involved in the present case, means only that it is a reactor which uses fast neutrons and produces more high-grade fissionable material than it consumes.

The scientists working at Stagg Field in 1942 were not concerned with breeding. Seeking to demonstrate that a controlled fission chain reaction was possible, they used natural uranium (U^{238} with very small quantities of U^{235}) arranged in lumps and separated by graphite as a moderator. The critical size was large—the reactor was literally an atomic pile upon the floor of a squash court. The rate of reproduction and power level were controlled by long steel rods containing boron. Since there was no shield

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to prevent the escape of radiation, the Chicago pile was never allowed to run at high levels.

Atomic Bombs.—Scientific progress has moved from Stagg Field along two paths. First, there was the atomic bomb. The bomb used the energy released by simultaneous fission of many atoms to cause an explosion. The explosion required a very high rate of neutron reproduction, much higher than the rate in a reactor. It was necessary to bring highly fissionable materials together with very great rapidity into a mass much greater than the critical size for sustaining a chain reaction. This cannot happen in a power reactor. There is absolutely no danger of any accident resembling an atomic bomb explosion.

Power Reactors.—The second line of progress has been in the development of atomic reactors for peaceful purposes—research, manufacture of isotopes, propulsion, and production of electricity. Perhaps the most important ultimate potential purpose is electric power. Even in the United States the supply of fossil fuels is not unlimited, and important areas are too far away to use hydroelectric power. The demand for power is still growing rapidly. Abroad there are vast numbers of people who cannot realize their economic expectations and build stable communities without adequate sources of power. Many of them lack water power and have no access to coal, oil or natural gas. Even if these fuels were available, the transportation costs would be prohibitive. Since tiny quantities of atomic fuel will produce vast amounts of energy, the power reactor gives promise of filling

a tremendous human need. Its long-run economic and social importance can hardly be exaggerated.

There are already some 115 reactors operating in the United States with diverse designs, purposes and power levels. About 90 more are under construction. Of these, 4 in operation and 11 being built are large-scale developmental power reactors, which produce and deliver electric power for use in a normal utility system. The PRDC reactor will be the first fast neutron breeder among these privately owned developmental power reactors; the others are thermal (i.e. slowed-neutron) reactors of various types and designs. See *Nuclear Reactors Built, Building or Planned in the United States as of June 30, 1960,* TID 8200 (AEC, 2d Rev. 1960). The early reactors, as well as some of the later, are owned by, or operated under contract with, the Atomic Energy Commission or the United States Department of Defense. In the Atomic Energy Act of 1954, however, Congress adopted the policy of encouraging widespread private participation in the development and utilization of atomic energy for peaceful purposes "to the maximum extent consistent with the common defense and security and with the health and safety of the public" (Section 3(d)). The Act authorizes the AEC to issue permits for the construction of atomic power plants (Section 185) and licenses for operation (Section 104(b)).

2. THE PRDC POWER REACTOR

On January 6, 1956, Power Reactor Development Company (hereinafter called "PRDC") submitted an

application for a license to design, construct and operate a developmental fast-neutron breeder reactor for the generation of electric energy at Lagoona Beach, Michigan, about 30 miles southwest of Detroit. PRDC is a non-profit membership corporation composed of utility [5] and industrial companies,[6] which was organized in 1955 "to study, develop, design, fabricate, construct and operate one or more experimental nuclear power reactors * * * to the end that there may be an early demonstration of the practical and economical use of nuclear energy for the generation of electrical energy * * *" (R. 388).

The heart of the plant covered by the application, as amended, is to be a core containing the fissionable materials (or atomic fuel). It will be an upright cylinder 31.5 inches high with a 30.5 inch diameter. The fuel will be in the form of very fine, solid but

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[5] PRDC has 13 operating utility members, and one service company representing four additional public utilities. These companies are: Central Hudson Gas & Electric Corp.; The Cincinnati Gas & Electric Co.; The Columbus and Southern Ohio Electric Co.; Consumers Power Co.; Delaware Power & Light Co.; The Detroit Edison Co.; Iowa-Illinois Gas and Electric Co.; Long Island Lighting Co.; Philadelphia Electric Co.; Potomac Electric Power Co.; Rochester Gas and Electric Corp.; The Toledo Edison Co.; Wisconsin Electric Power Co.; and Southern Services, Inc., representing The Southern Co. and its following four operating subsidiaries: Alabama Power Co.; Georgia Power Co.; Gulf Power Co.; Mississippi Power Co. (R. 722–723; Opinion, R. 681–682, n. 69).

[6] There are 7 industrial companies: Allis-Chalmers Mfg. Co.; The Babcock & Wilcox Co.; Burroughs Corp.; Combustion Engineering, Inc.; Fruehauf Trailer Co.; Holley Carburetor Co.; Westinghouse Electric Corp. (R. 722-723).

removable uranium pins running the length of the cylinder, 27% enriched in the fissionable isotope U^{235}, clad in zirconium and held in stainless steel subassemblies. There is no moderator. Two boron control rods are near the center. In addition, there are eight boron shut-down rods which would hang above the core during operation, ready for insertion to shut down the chain reaction by capturing neutrons if the occasion should arise. The shut-down rods are suspended by latches held by an electro-magnet so that the current can be shut off automatically and the shut-down rods will instantly fall into the reactor without human intervention if operation becomes abnormal.

The cylindrical core is surrounded by an axial and radial blanket composed of uranium from which the isotope U^{235} has been removed and which is arranged in removable elements. When the reactor is operating this blanket will not only serve as a shield to prevent the escape of radio activity released by fission but it will also capture free neutrons producing first the isotope U^{239} and then plutonium (Pu^{239}). It is this characteristic which makes the plant a breeder. The core and blanket together form a cylinder about 65 inches long and 80 inches in diameter.[7]

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[7] The core and the surrounding blanket of nonfissionable material (U^{238}) are surrounded and covered by a series of shielding layers and containment vessels, the outside wall consisting of concrete seven feet thick and, beyond that, a steel shell.

For the PRDC design, see R. 666–668, and Exhibits X, X–A to the PRDC application (Certified Transcript, pp. 5197–5362, 5605–5713).

When operating, the reactor will produce energy resulting from fission in accordance with the formula $E=mc^2$, most of which will be transformed into heat. To obtain electricity the heat must be efficiently transformed into steam with which to turn a conventional turbine generator. The PRDC plans call for pumping molten sodium through the core as coolant. The coolant will be sealed in a tight container but the system is so arranged that after passing through the reactor core the coolant moves through primary heat exchangers and thence, at reduced temperatures, back to the core. The heat exchanger transfers the heat from the primary coolant system to a secondary system which also uses liquid sodium. The second system carries its liquid sodium to the steam generators and the steam, in turn, moves the turbines just as if it were created in a boiler fired by coal. Sodium is used as a coolant because it is an efficient heat transfer agent and neither slows nor absorbs enough neutrons to affect either the breeding or the chain reaction. Two cooling systems are used in order to reduce the danger of the escape of radiation.

The PRDC reactor is to have a rated capacity of 300,000 kilowatts of heat, which will yield 100,000 kilowatts of electricity; at the same time, it will produce 20 percent more fissionable material than it consumes. Since the success of a fast breeder will increase the nuclear fuel available from natural sources more than a hundred times, it is one of the most "promising" approaches to feasible atomic power at the present time and its success seems "indispensable" to the future development of the wide-

spread use of such power. See R. 709, 737–738, 804–808, 831–832.[8]

The safety hazard of the PRDC reactor—like that of any other power reactor—is not that it could explode like an atomic bomb, but that it might release radioactive material into the atmosphere. As the eminent atomic physicist Professor Hans Bethe explained in this case (R. 739), "it is * * * impossible that the reactor ever explode like an atomic bomb. There is no way in which this could ever happen."

The trigger of an atomic bomb is especially designed to force critical quantities of very highly refined fissionable materials together in a few millionths of a second, thus causing a very rapid chain reaction in which tremendous quantities of energy are immediately released. The atomic fuel in a reactor is usually not so highly refined. There is no trigger for forcing it into a critical mass in the short space of time. If a nuclear accident should happen in a reactor it would be "at the worst, comparable to a boiler explosion" (R. 750).

Thus the hazards of nuclear reactors lie in the possibility that radioactive fission products which have been formed by the operation of the reactor may escape into the atmosphere and cause a radiation hazard

[8] The fast neutron breeder reactor was one of the types described to Congress during the hearings on the Atomic Energy Act of 1954 as a possible method for economic production of electricity from atomic power. See Hearings on S. 3323 and H.R. 8862 before the Joint Committee on Atomic Energy, 83d Cong., 2d Sess., pp. 493–494, 565, 568, 2 Leg. Hist. 2127–2128, 2203, 2206; 100 Cong. Rec. 10432–10433, 3 Leg. Hist. 3253–3254.

for the surrounding area. (R. 739; see also R. 741-742, 750, 798, 876–877.)

In normal operation, the radioactive fission products are confined in the fuel elements in the reactor. Escape of such material could hypothetically result from a series of mechanical failures of the fuel elements, the reactor vessel and other containment features (R. 742–743), or from a nuclear accident in which there occurs a rapid increase in the rate of neutron reproduction, an overheating and melting of the fuel, and a release of gases and energy sufficient to breach the containment (R. 744).

All reactors, including fast neutron breeders, have a series of cumulative safeguards to insure that no single failure of equipment or error or omission could cause an accident (R. 740, 881–886). Thus, the reactor core must be designed so as to be inherently stable and easily controlled; and it is built so that it will automatically shut down if specified operating levels well below any danger point are exceeded. In most reactors, as in the one here involved, the fissionable material used as fuel is loaded in the form of solid elements fixed in a rigid structure and a number of movable rods containing a neutron absorber are used to regulate power and to shut down operation (R. 735–736). The configuration of the reactor fuel and control rods is fixed to provide control and margins of safety. The design may include limitations upon the rate at which reactivity (the rate of neutron reproduction) can be increased, and thus avoid an uncontrollable rise in power (R. 746, 750–751). Fur-

ther, the reactor core is designed to make any such incident self-limiting, in that increases in temperature or power should decrease reactivity (R. 754, 759, 881). Moreover, aside from the use of control rods by the operator to regulate power and shut down the reactor, there are "scram" mechanisms which will automatically cause shut-down if specified levels of operation are exceeded, and will "fail safe", *i.e.*, shut down if the scram device itself is not functioning properly (R. 744–745).

At the time the PRDC construction permit was granted, the design of fast breeder reactors had not been perfected up to the foregoing standards although the Atomic Energy Commission, as explained below, found that in all probability the difficulties could be solved. The special characteristics of fast neutron reactors pose three particular hazards not associated with thermal reactors. *First,* if the neutron reproduction rate were to increase beyond a certain level, the power would rise more rapidly than in a thermal reactor (R. 750, 797–798, 808). *Second,* there may be certain instabilities in the core of a fast reactor, with the possible consequence that a rise in power would not be self-limiting, but would lead to further progressive power increases (R. 671–672, 704, 753–759, 795, 838–839). *Third,* since the core of a fast reactor contains a large amount of fissionable material in a small volume, a rapid melting of the core and a concentration of the molten fissionable material into much

more than a critical mass, could cause a boiler-type explosion (*supra*, p. 15) (R. 670, 752–753, 833–834).[9]

It is unnecessary to explain these problems in any detail save to point out as an illustration that instability in the core may be caused by the pins of fissionable material bowing inward as the heat in the reactor rises. Rearrangement of the fissionable materials might then increase the rate at which neutrons were reproduced (see p. 6, *supra*), and thus the bowing might conceivably cause a nuclear runaway before the reactor could be shut down. Manifestly, this problem of design would have to be solved before a fast breeder reactor could be permitted to operate at the PRDC location.[10]

A power reactor has further cumulative safeguards

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[9] There are, on the other hand, important respects in which a fast reactor may be safer than a thermal one. Because fast neutrons are not easily captured by fission products and other materials, it is not necessary to build in a large potential neutron reproduction rate to override such effects; unlike thermal reactors, fast reactors can be fueled so that no rapid uncontrolled rise in power is possible (R. 672, 704–705, 748–749, 797). In addition, the fast reactor's short fuel-loading cycle minimizes the amount of fission products, and the system's low pressure minimizes mechanical stress (R. 741, 753–754).

[10] The Commission is now operating one experimental fast breeder reactor (EBR–I) (R. 786–796, 828–830, 835–839), and is constructing a second such experimental facility (EBR–II) (R. 804–815, 839–841). It also has had a number of such reactors used for research purposes which operate on a small scale without any production of power (R. 822–827, 841–845). The United Kingdom Atomic Authority has an active fast breeder program and its first developmental fast breeder power reactor commenced operation at Dounreay, Scotland, in November 1959 (see R. 738, 851–852). See the Commission's opinion, R. 669, 702.

to prevent injury even if an accident occurs in the core. Physical barriers contain the fission products within fuel elements in the reactor core; the reactor core is covered by a steel vessel; it has a massive radiation shield and, in some cases, as here, a gas-tight reactor compartment; and it is housed in its own building. In addition, all power reactors not located in remote areas are further enclosed in a steel vapor shell designed to contain all gaseous fission products which could be released in the maximum credible accident. (R. 742–744, 881–882, 884.)

Thus far, there have been no injurious accidents in the routinely-operating reactors. Prior to 1961, the incidents that had occurred in experimental facilities had not resulted in any fatality or in any injury to the public. (See R. 351, 878–881.) On January 3, 1961, an explosion occurred at an experimental nuclear reactor at the Naval Reactor Testing Station, Arco, Idaho, as a result of which three servicemen inside the reactor building were killed. This first fatal accident is now under investigation. While the cause has not yet been determined, it does appear that no significant radioactive material was released beyond the reactor area, even though the reactor was not enclosed in a vapor shell.

3. PROCEEDINGS BEFORE THE COMMISSION

On August 4, 1956, seven months after receipt of the PRDC application, the Commission issued a provisional construction permit, subject to the right of any interested party to request a hearing (R. 516–

523). The labor unions which are respondents in this Court and certain of their officers filed petitions for intervention requesting a hearing. The petitions were granted (R. 576–583). A lengthy hearing was held before a hearing examiner. The chief issues—the only issues relevant here—related to the safety of the proposed reactor. At the close of the hearing the record was certified to the Commission. After hearing oral argument, the Commission issued an opinion and initial decision affirming and continuing in effect the construction permit, with amendments (R. 607–629, 918–938). Following the filing of exceptions and further briefs, the Commission issued an Opinion and Final Decision and an Order (R. 630–720), which "amplif[ied] and affirm[ed]" its initial decision (R. 631).

The decision rejected the unions' contention that no construction permit should be issued because there was insufficient foundation in the record for a finding that the proposed reactor could be operated with "adequate protection to the health and safety of the public" (Section 182(a)). The Commission proceeded upon the view that, since the issue related only to a construction permit under Section 185, no final conclusion upon the safety of operations was required. Its opinion contains numerous subsidiary findings pertaining to the safety of the projected operation and concluded (R. 708)—

> The Commission finds reasonable assurance in the record, for the purposes of this provisional construction permit, that a utilization facility of the general type proposed * * * can be con-

> structed and operated at the location without undue risk to the health and safety of the public.

The strictness of the Commission's definition of "undue risk" is revealed by another finding. It ruled that a definitive finding that there was no "undue risk", which would have to be made before a license to operate the reactor was granted, would require proof of (R. 707)—

> the inherent safety of the reactor and a demonstration that no credible accident can release significant quantities of fission products into the atmosphere. * * *

Although the Commission found "reasonable assurance" that this proof would be forthcoming, it repeatedly stated that it will not issue an operating license unless, after another full hearing, it is satisfied that operation will satisfy the Act's safety criteria (R. 634–635, 650, 676, 679–680, 712, 716, 718–719). It emphasized (R. 646–647) that "public safety is the first, last, and a permanent consideration in any decision on the issuance of a construction permit or a license to operate a nuclear facility."

The Commission thereupon continued the amended construction permit. The permit expressly stated that it did not constitute final approval of any technical specification, which approval would be required before an operating license is issued (R. 716), and expressly reserved jurisdiction to reopen the proceeding at any time prior to the issuance of an operating license for further evidence and for consideration of data pertinent to safety (R. 712, 714, 718–719).

4. THE DECISION OF THE COURT OF APPEALS

Upon respondents' petition for review the court of appeals set aside the order granting a construction permit. The majority ruled (1) that the respondent unions had standing to maintain the action, and that the Commission's grant of the permit was invalid because the Act requires the agency, before it grants a construction permit, to make the same finding of safety of operation that it makes before granting an operating license; (2) that the Commission's safety findings were ambiguous because they failed to state "a positive opinion regarding safety of operations"; and (3) that the findings were deficient because the Commission did not specifically find that there were "compelling reasons" for locating the reactor near a heavily populated area "where it will expose so large a population to the possibility of a nuclear disaster" (R. 953–965). Judge Burger dissented (R. 965–968).

Petitions for rehearing *en banc* were denied (Judges Miller and Bastian dissenting, and Judges Washington and Burger not participating) (R. 970–971).

SUMMARY OF ARGUMENT

I

The Commission's order granting PRDC a construction permit—not an operating license—for a developmental atomic power reactor is based upon a finding of "reasonable assurance * * * that a utilization facility of the general type proposed * * * can be constructed and operated at the location without undue risk to the health and safety of the public"

(R. 708). The Commission further stated that before issuing an operating license it would "require that all safety questions be answered to our complete satisfaction" (R. 634–635). The Commission here followed the same practice as in all the other cases in which it authorized the construction of developmental power reactors: granting a construction permit upon a finding of reasonable assurance of the operating safety of the type of reactor proposed, but deferring a definitive determination of the operating safety of the particular reactor design actually built to the proceedings for the operating license. We submit that this two-step procedure accords with the Atomic Energy Act of 1954 and the Commission's regulations, and that the court of appeals erred in holding that the same findings required for the issuance of an operating license must be made before granting a construction permit.

A. 1. One of the basic purposes of the Act was "to encourage widespread participation in the development and utilization of atomic energy for peaceful purposes" by the Nation's industrial and utility firms (Section 3(d)). The keystone of the Act's detailed regulatory system is Commission licensing of atomic production and utilization facilities. Section 185 provides a two-step procedure for licensing the construction and operation of reactors: the initial issuance of a construction permit "if the application is otherwise acceptable to the Commission," and the subsequent grant of an operating license if certain conditions are satisfied.

2. A basic concern of Congress evidenced in this Act was to insure maximum protection for the public health and safety in the development of the peaceful uses of atomic energy through regulations and findings to be made by an expert body—the Atomic Energy Commission. Both Sections 103 and 104, which authorize the Commission to issue reactor licenses, and Section 182(a), which prescribes the content of applications for licenses to operate production or utilization facilities, require the Commission, before it grants a license, to find that there will be adequate protection to the public health and safety. When Congress confided to the Commission the task of protecting the public health and safety, it did not attempt to lay down detailed instruction for dealing with this highly specialized, technical and scientific subject, but gave the agency broad authority to formulate more precise requirements through the exercise of rule-making power. Sections 161(b), 161(i).

The broad power thus conferred upon the Commission encompasses the entire spectrum of health and safety regulation. It plainly includes the establishment of safety standards and procedures, including the prerequisites to be met at various stages in the licensing procedure.

B. Pursuant to the legislative design the Commission promulgated regulations designed to protect the public health and safety in all aspects of the development and use of atomic power. The regulations distinguish between the preliminary safety finding to be made before issuing a reactor construction permit

and the ultimate finding which is required for an operating license. Regulation 50.35 provides that where, "because of the nature of a proposed project," an applicant is unable to provide the necessary technical information, including final data bearing upon health and safety, the Commission may grant a construction permit on a provisional basis if it has information sufficient to provide reasonable assurance that a facility of a proposed type "can be constructed and operated at the proposed location without undue risk to the health and safety of the public"; and that, prior to issuance of an operating license, the Commission will determine whether the "final design" provides reasonable assurance that public health and safety will not be endangered.

The reasons for adopting this two-step procedure with respect to safety are inherent in modern scientific methods and the present state of the art. In the scientific world one can often predict with a substantial degree of assurance the development of knowledge, engineering techniques and materials before they are actually available. Where both the construction of the facility and the final development of design and materials will cover a considerable period, the public acquires the benefits of the facility much earlier if both the construction and the research and development go forward simultaneously. Furthermore, there are often uncertainties and technological problems that can be resolved only during the course of construction. For these reasons, a definitive safety evaluation frequently cannot be made

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until the completion of construction and final testing. When the Commission issues a provisional construction permit for a developmental reactor, the most it can do is to make a finding of reasonable assurance that a reactor of that type can be safely constructed and operated at the proposed site.

C. 1. The two-step procedure provided in Regulation 50.35 is authorized by Section 185 of the Act. That section expressly provides for the issuance of construction permits and operating licenses, in two steps, and it obviously contemplates different standards for each step. The only condition imposed upon the grant of a construction permit is that the application be "otherwise acceptable to the Commission." For a subsequent operating license, however, Section 185 specifies conditions, including a finding that the facility will be operated in conformity with the applicable statutory provisions and regulations, and the "absence of any good cause being shown" why the granting of a license would not accord with the Act. The latter standards were intended to assure that the statutory criteria for safe operation would be met before an operating license is issued. The absence of specific standards governing the grant of construction permits were evidently designed to give the Commission the broadest discretion in formulating appropriate safety standards at this stage of the proceeding. This is further shown by Section 182, which requires that the statutory safety standard of providing adequate protection to the public health and safety must be satisfied before a license "to operate" may be is-

sued. Had Congress intended in Section 185 to apply the same standard to the grant of a construction permit, which does not authorize operation, it would have said so.

2. Apart from Sections 182 and 185, Regulation 50.35 is also valid as a reasonable exercise of the Commission's broad rule-making power to "prescribe such regulations or orders as it may deem necessary * * * to protect health and to minimize danger to life or property" (Section 161(i)). The scientific and technological factors previously described (*supra*, pp. 25–26) fully justify deferring the determination of final operating safety until construction is completed. Such deferral enables the Commission to make that determination on the basis of the latest scientific and technological information.

3. The legislative history of the 1954 Act confirms the view that definitive safety findings are not required for the issuance of a construction permit. The provision in Section 185 imposing, as one of the conditions for the grant of an operating license, "the absence of good cause being shown" why the grant of such license would not accord with the Act, gives the Commission the power to deny a license even though construction is carried out in accordance with the permit. This was a deliberate departure from the Communications Act of 1934, under which all definitive decisions with respect to the application must be made when the agency issues a construction permit. Congress rejected a proposal that the "good cause" provision of the Atomic Energy Act should be changed

so that all fundamental determinations should precede construction and that a license should be assured when construction is completed. Since the Act thus contemplates some further determination before an operating license is issued, it cannot be read to compel a definitive safety finding prior thereto.

When read in context, the two items of legislative history invoked by the court below as the basis for its decision are not in point. The principal item, a colloquy between Senators Humphrey and Hickenlooper, had nothing to do with the safety features of the bill, but related to economic issues concerning the public or private development of atomic electric power.

4. Any doubt concerning our interpretation of the Act should be removed by the Commission's frequent reports to the Joint Congressional Committee on Atomic Energy, which described and explained the Commission's two-step practice of issuing provisional construction permits without making definitive safety findings, and the Committee's apparent acquiescence in the practice.

D. In Finding 22 the Commission concluded (R. 708):

> The Commission finds reasonable assurance in the record, *for the purposes of this provisional construction permit*, that a utilization facility of the general type proposed in the PRDC Application and amendments thereto can be constructed and operated at the location without undue risk to the health and safety of the public. [Emphasis added.]

Apart from the italicized phrase "for the purposes of this provisional construction permit," this finding uses the very words of Regulation 50.35. The court below thought, however, that the italicized phrase in Finding 22 (also used elsewhere in the Commission's decision) so weakened the Commission's "reasonable assurance" finding that neither the Act nor the Regulation was satisfied.

We submit, however, that the italicized phrase was not intended to, and did not, derogate in any way from the basic finding, repeated several times without the reference (R. 665, 676–677, 710–711), that there was reasonable assurance that a reactor of this general type could be operated at this site without undue risk to public health and safety. The phrase served two purposes. First, it reemphasized and made particularly explicit, in the Commission's first contested reactor construction licensing case, that the grant of the construction permit was not to be taken as any indication that the safety findings there made would automatically lead to an operating license. Second, it underscored the Commission's ruling that the issuance of a construction permit required no more than the finding set forth in Regulation 50.35 as to the type of reactor, and did not require a definitive safety evaluation of the particular reactor. Indeed, whenever the Commission finds, in issuing a construction permit, that there is reasonable assurance that a facility of the type proposed can be operated consistently with the public health and safety, such finding is necessarily

made for the purposes of the particular construction permit involved.

The court of appeals erred in holding (R. 963) that the Commission's findings are ambiguous because of the Commission's "repeated expressions of uncertainty" on the one hand, and its "positive opinion regarding safety of operation" on the other. The alleged ambiguity involves no more than the distinction, clearly drawn in the regulations, between the two types of findings made by the Commission in granting a construction permit for a developmental reactor; a present conclusion (the "positive opinion") as to the safety of the general type of reactor proposed, and a more tentative conclusion (the alleged "expressions of uncertainty") as to the eventual demonstration of the safety of the "final design" in the light of the applicants' research and development program.

The Commission's ultimate safety findings rest on a number of subsidiary findings covering the various factors relevant to that issue, and these subsidiary findings are supported by an extensive record which contains detailed evidence relating to all aspects of the PRDC reactor. The respondents do not challenge the sufficiency of the supporting evidence.

II

Neither the language nor the legislative history of the Act justifies the court of appeals' ruling that the Commission cannot locate a reactor near a populated area unless it finds "compelling reasons" there-

for. Both support the Commission's settled practice of treating the site as one of the many factors upon which its overall ultimate judgment as to operating safety is based. Furthermore, the court's statement that the location of the PRDC reactor approximately 30 miles from Detroit will "expose" a large "population to the possibility of a nuclear disaster" has no support in, and is contradicted by, both the Commission's findings and the evidence upon which they rest.

1. The only statutory test concerning safety which Congress has established as the prerequisite to the grant of a construction permit, or even of an operating license, is a general finding of adequate protection to the public health and safety. Sections 104(d), 182(a). This statutory finding requires an evaluation of many factors, including the nearness to a populated area; it is for the Commission, however, to determine the weight to be given to this factor, as well as to all the others, in making the statutory finding.

Nothing in the statute justifies the court of appeals' special subordinate finding of "compelling reasons" for locating a power reactor in a populated area. On the contrary, the Act explicitly delegates to the Commission the responsibility for determining whether a particular plant location will provide adequate protection for the public health and safety. Sections 161(i)(3), 182(a). Pursuant to these provisions the Commission has issued Regulation 50.34, which requires submission of detailed information relating to the safety characteristics of the site.

In the present case the Commission gave careful attention to the proposed location; and its ultimate finding of safety was based, among others, on the finding of reasonable assurance that a reactor of a proposed type can be constructed and operated "at the location" without undue risk to public health and safety. Respondents do not attack these findings and, in any event, there is substantial evidence to support them.

2. One of the basic purposes of the Act was to foster progress in atomic power development by encouraging the widespread participation of private industrial and utility companies and publicly-owned utilities. Effective participation by utilities, however, may be curtailed if large power reactors must be located in remote areas and cannot be placed in the utility service areas, or within a reasonable distance to provide feasible service to the utilities' metropolitan and industrial consumers. The Act thus implicitly recognizes that there are strong counterbalancing factors that offset the greater safety that would necessarily result if every reactor were located in a remote area. Of course, the proximity of the population demands a higher degree of safety. The Commission acknowledged this and took it into account in its decision.

3. The Commission's procedure in this case followed the same course as in all other applications to license the construction or operation of a reactor. Construction permits for such reactors have been issued after full consideration of all the pertinent criteria

that bear upon safety at the proposed site, but the Commission has never made a special finding of "compelling reasons" for locating a reactor near a populated area. Location 30 miles from a large center of population has never been considered disqualifying *per se*, although it may call for certain additional design features or the imposition of conditions upon operation—as the Commission may require in the instant case before authorizing operation.

4. The Commission's policy on reactor location is explicitly validated by the legislative history of the Act. Congress contemplated that the safety regulation it was committing to the Commission's discretion included supervision of the location of reactors. Congress also understood, and anticipated, that many power reactors (like conventional generating facilities) would be located near metropolitan centers during the developmental stage of atomic power. There is nothing to the contrary in the 1957 Report of the Commission to the Joint Committee on Atomic Energy, mentioned by the court of appeals.

ARGUMENT

I

THE ATOMIC ENERGY COMMISSION SATISFIED THE REQUIREMENTS OF THE ATOMIC ENERGY ACT OF 1954 AND OF ITS OWN REGULATIONS IN GRANTING THE PRDC CONSTRUCTION PERMIT

The order challenged by respondents in the court below granted only a provisional construction per-

mit—not an operating license. The order is based upon a finding of (R. 708)—

> reasonable assurance * * * that a utilization facility of the general type proposed in the PRDC Application and amendments thereto can be constructed and operated at the location without undue risk to the health and safety of the public.

The finding was made only for the purposes of this provisional construction permit (R. 708). Construction creates no special hazards. The Commission also ruled that before issuing an operating license it would "require that all safety questions be answered to our complete satisfaction" (R. 634–635), and it reserved the right to consider (R. 712)—

> whether the PRDC plant can be *operated* with reasonable assurance for the protection of the health and safety of the public.

Thus the safety finding made by the Commission on the construction permit differed in two respects from the finding which it will require before granting a license to operate. *First,* the construction permit finding referred to "a utilization facility of the general type proposed" whereas the operating license, if granted, would cover the specific reactor exactly as designed. *Second,* the construction permit finding contemplated a somewhat lower degree of assurance concerning safety than would be required for a license to operate. These differences are due to the nature of scientific progress and reactor construction.

Many safety problems would have to be solved, many details of the design would have to be developed and many safety tests would have to be conducted while construction was in progress. The procedure followed in this case conformed to the Commission's uniform practice in like cases.

The court of appeals held that the very findings required for the issuance of an operating license must be made before granting a construction permit. We submit that this was error and that the two-step procedure followed by the Commission accords with the statute and its own regulations.

A. THE STATUTORY PROVISIONS

One of the basic purposes of the Atomic Energy Act of 1954 was "to encourage widespread participation in the development and utilization of atomic energy for peaceful purposes" by the nation's industrial and utility firms (Section 3(d), *infra,* p. 93). Participation by the latter in the development of reactors for the production of electricity, in "teamwork" with the Government, was considered necessary "to optimum progress, efficiency, and economy in this area of atomic endeavor" (S. Rep. 1699, 83d Cong., 2d Sess., p. 9, 1 Leg. Hist. 757). "[T]he goal of atomic power at competitive prices will be reached more quickly if private enterprise * * * is now encouraged to play a far larger role in the development of atomic power" (S. Rep. 1699, 83d Cong., 2d Sess.,

p. 3, 1 Leg. Hist. 751). This new source of electric energy "should be integrated into the existing power economy of the Nation; * * * nuclear power should be produced and distributed by the private and public power systems" (Hearings on S. 3323 and H.R. 8862 before the Joint Committee on Atomic Energy, 83d Cong., 2d Sess., p. 575, 2 Leg. Hist. 2213). As the President stated in his message on the bill, the new industry should be developed "in a manner as nearly normal as possible" (H. Doc. 328, 83d Cong., 2d Sess., p. 6, 1 Leg. Hist. 50).

1. *The Licensing System.*—The Act provides a detailed regulatory system for the development of the peaceful uses of atomic energy by sources other than the Atomic Energy Commission. The keystone is a licensing system, which requires a Commission license for the manufacture, production, transfer, acquisition, possession, use, import or export of any facility for using or producing fissionable materials or reactor products (Section 101, *infra,* p. 109). Two types of licenses for utilization and production facilities (reactors) are contemplated: commercial licenses, which may be issued only after the Commission has found that the type of facility "has been sufficiently developed to be of practical value for industrial or commercial purposes" (Sections 102 and 103, *infra,* pp. 109–111); and research and development licenses (Section 104, *infra,* p. 111). The Commission is authorized to issue development licenses for power reactors, as "utilization and production facilities in-

volved in the conduct of research and development activities leading to the demonstration of the practical value of such facilities for industrial or commercial purposes", and to give "priority" to those which, it believes, will "lead to major advances in the application of atomic energy for industrial or commercial purposes". Section 104(b).

Section 182 prescribes the manner of applying for a license and certain proceedings to be held thereon.

Section 185 provides a two-step procedure for licensing the construction and operation of reactors (*infra*, p. 126). It provides for the initial issuance of a construction permit upon application "for licenses to construct or modify production or utilization facilities * * * if the application is otherwise acceptable to the Commission." Section 185 further states that, later, the Commission is to grant an operating license (under Section 103 or 104), if certain conditions are satisfied: (1) "the completion of the construction * * * of the facility"; (2) "the filing of any additional information needed to bring the original application up to date"; (3) a "finding that the facility authorized has been constructed and will operate in conformity with" the amended application and appropriate statutory provisions and regulations; and (4) "the absence of any good cause being shown to the Commission why the granting of a license would not be in accordance with the provisions of this Act."

2. *Protection of the Public Health and Safety.*— A basic concern of Congress evidenced in the Act was

to insure maximum protection for the public health and safety in the development of the peaceful uses of atomic energy. Congress found that "regulation by the United States of the production and utilization of atomic energy and of the facilities used in connection therewith is necessary in the national interest * * * to protect the health and safety of the public" (Section 2(e), *infra*, p. 92). Congressional concern for the public health and safety is also set forth in Section 3(d), which states that one of the purposes of the Act is to provide for "a program to encourage widespread participation in the development and utilization of atomic energy for peaceful purposes to the maximum extent consistent with * * * the health and safety of the public" (Sec. 3(d), *infra*, p. 93).

The same concern is evident in the provisions which deal directly with licensing. Section 103(b) provides:

> The Commission shall issue such licenses on a nonexclusive basis to persons applying therefor * * * who are equipped to observe and who agree to observe such safety standards to protect health and to minimize danger to life or property as the Commission may by rule establish; * * *

Section 104(b), from which the Commission derives the authority to issue licenses for reactors involving research and development, such as the PRDC reactor, provides that in issuing developmental licenses

> [t]he Commission shall impose the minimum amount of such regulations and terms of license as will permit the Commission to fulfill its

> obligations under this Act * * * to protect the health and safety of the public * * *.

A license may not be issued if, in the opinion of the Commission, its issuance would be "inimical to the * * * health and safety of the public." Section 104(d).

Section 182(a), which prescribes the content of applications for licenses to operate production or utilization facilities, requires the following information concerning safety—

> such technical specifications, including information of the amount, kind, and source of special nuclear material required, the place of the use, the specific characteristics of the facility, and such other information as the Commission may, by rule or regulation, deem necessary *in order to enable it to find* that the utilization or production of special nuclear material * * * *will provide adequate protection to the health and safety of the public.* * * * [Emphasis added.]

As these sections show, Congress confided to the Commission the task of protecting the public health and safety. The problems are highly specialized, technical and scientific. Therefore Congress did not attempt to lay down detailed instructions but gave the agency authority to formulate more precise standards through the exercise of rule-making power. Section 161(b), *infra*, p. 116, authorizes the Commission to

> establish by rule, regulation, or order, such standards and instructions to govern the possession and use of special nuclear material,

> source material, and byproduct material as the Commission may deem necessary or desirable * * * to protect health or to minimize danger to life or property.

Section 161(i), *infra*, p. 116 authorizes the Commission to

> prescribe such regulations or orders as it may deem necessary * * * (3) to govern any activity authorized pursuant to this Act, including standards and restrictions governing the design, location, and operation of facilities used in the conduct of such activity, in order to protect health and to minimize danger to life or property.

Sections 53(c) and 81 (*infra*, pp. 101–102, 108–109) make licenses for special nuclear and byproduct material subject to "such safety standards as may be established by rule of the Commission * * *." And, as pointed out above, Section 103(b)(2) provides for the granting of non-exclusive commercial licenses for utilization or production facilities to persons "who are equipped to observe and who agree to observe such safety standards to protect health and to minimize danger to life or property as the Commission may by rule establish."

Thus Congress gave the Commission broad power to establish the requirements necessary to protect life, health and property in the development and use of atomic energy for peaceful purposes. The very breadth of the phrases demonstrates that the Commission's delegated authority encompasses the entire spectrum of health and safety regulation—the formu-

lation of policies, the evaluation of scientific information, the fixing of standards and their application to specific cases. This power, we submit, plainly includes the establishment of safety standards and procedures including the prerequisites to be met at various stages in the licensing procedure.

Congress adopted this course because it recognized that protection of the public health and safety in the atomic energy field was an area of "special competence" in which the "responsibility" of the Commission (100 Cong. Rec. 10079, 3 Leg. Hist. 3103) could best be accomplished through the agency's rule-making powers.[11] As the President stated, in recommending to Congress the legislation that became the 1954 Act, "flexibility is necessary in licensing and regulatory provisions of the legislation. Until further experience with this new industry has been gained, it would be unwise to try to anticipate by law all of the many problems that are certain to arise." H. Doc. 328, 83d Cong., 2d Sess., p. 7, 1 Leg. Hist. 51.

[11] That the Commission was intended to use its rule-making power to carry out its broad discretion to protect the public health and safety was clearly noted in references to Section 161 during the legislative consideration of the 1954 Act. See S. Rept. 1699, 83d Cong., 2d Sess., p. 26, 1 Leg. Hist. 774; H. Rept. 2181, 83d Cong., 2d Sess., p. 26, 1 Leg. Hist. 1022; Hearings on S. 3323 and H.R. 8862 before the Joint Committee on Atomic Energy, 83d Cong., 2d Sess., pp. 465, 601, 2 Leg. Hist. 2099, 2239; H. Doc. 328, 83d Cong., 2d Sess., p. 7, 1 Leg. Hist. 51.

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B. THE COMMISSION'S REGULATIONS AND PROCEDURES

Pursuant to the legislative design the Commission promulgated detailed regulations designed to protect the public health and safety in all aspects of the development and use of atomic power. The regulations pertinent to the construction and licensing of atomic reactors are Regulations 50.34, 50.35 and 50.40 (10 CFR 50.34, 50.35, 50.40, *infra*, pp. 133–136).

Regulation 50.34 specifies the technical information to be contained in each application for a license or construction permit. The required information includes a description of the process to be performed that is "sufficiently detailed to permit evaluation of the radioactive hazards involved" (§ 50.34(a)); a detailed description of the site for the facility (§ 50.34(c)); a "description of plans or proposals in the event that acts or accidents occur which would create radioactive hazards" (§ 50.34(e)); and an "evaluation of the proposed measures and devices to prevent acts or accidents which would create radioactive hazards or to protect against the consequences should such acts or accidents occur" (§ 50.34(g)). Upon the basis of all this information, the Commission makes its determination with regard to the public health and safety.

The regulations distinguish between the ultimate safety finding to be made before issuing a construction permit and that which is required for a license to operate. Regulation 50.35 provides that where, "because of the nature of a proposed project," an applicant is unable to provide the necessary technical information, including final data bearing upon health

and safety, the applicant shall indicate the reason for such omission and the date when it will be supplied, and that

> If the Commission is satisfied that it has information sufficient to provide reasonable assurance that a facility of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public and that the omitted information will be supplied, it may process the application and issue a construction permit on a provisional basis without the omitted information subject to its later production and an evaluation by the Commission that the final design provides reasonable assurance that the health and safety of the public will not be endangered.

It will be observed that there are two chief differences between the safety findings required for a provisional construction permit and those prerequisite to an operating license. First, the finding for a permit covers only "a facility [*i.e.*, a reactor] of the general type proposed" whereas the license will not be issued until the Commission is satisfied that "the final design" provides reasonable assurance that operation of the reactor will not endanger the public. Second, the degree of safety assurance required for the permit is somewhat less. It calls for an informed prediction concerning what can be done on the site—a prediction made with full knowledge that the design is not complete and that full information is lacking. At this stage an investment is at stake, and private, and some-

times public resources are committed, but there is no threat to health or safety. The construction of a reactor presents no dangers. Its operation would, however, endanger the public unless there is full assurance of its safety. Consequently, the Commission warns applicants, as it repeatedly told PRDC (R. 634–635, 649–650, 676, 679–680, 712, 716, 718–720), that the issuance of a permit does not imply any commitment to an operating license. And Regulation 50.35 requires the strongest kind of finding as to safety before the license to operate will be issued.

The Commission has regularly followed this procedure in licensing reactors. It has been applied to every developmental power reactor and to most research and testing reactors.[12]

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[12] The licensed developmental power reactors are listed in Appendix B, *infra*, pp. 137–138. When the PRDC construction permit was issued, and up to the time of the decision here under review, construction of all the other (eight) developmental power reactors had been authorized under provisional construction permits on the basis of the same 50.35 procedure and findings followed in this case. Subsequent to the court of appeals' decision in this case and in a stated attempt to comply with it, a Commission hearing examiner, in an intermediate decision granting a construction permit, made not only the finding as to the safety of the general type of reactor required by Regulation 50.35, but also a finding as to the safety of the particular design described in the application. However, he further pointed out that there were specific safety questions that had not yet been resolved and on which information would have to be submitted before an operating license could be issued. *Pacific Gas & Electric Co.*, AEC Docket No. 50–133, October 17, 1960, pp. 47–50. This decision became final in the absence of exceptions or action by the Commission on its own motion.

The Commission also reviews its own developmental power reactors (*infra*, pp. 138–139) in proceedings similar to licensing proceedings. AEC Public Announcement B–42, March 12, [illegible]/5

The reasons for adopting this two-step procedure with respect to safety are inherent in modern scientific methods and the present state of the art. It is commonplace in the scientific world that one can often predict with a high degree of assurance the development of knowledge, engineering techniques or materials before they are actually available. This is especially likely to be true where the basic research has been completed and theoretical calculations can be projected in advance of construction and testing. Where both the construction of a facility and the final development of design or materials will cover a considerable period, the public acquires the benefits of the facility much earlier if both the construction and the research and development go forward simultaneously. Furthermore, there are often uncertainties and technological problems which can be resolved only during the course of construction. As Dr. Mark Mills testified in the present case, "Practically all advanced technological developments take place with a sort of combined construction and research and development and necessary dovetailing of these things * * *" (R. 73–74).

These generalizations apply to atomic science. Dr. Hans Bethe testified, "The simultaneous pursuit of programs of research, development and construction has become standard in the fast-moving field of atomic energy" (R. 739). So swift-moving is the technology of atomic power reactors, that a preliminary proposed design is normally submitted with the understanding that many features "will be determined and demonstrated during its actual construction" (R. 668, 676).

The design will be changed and improved on the basis of additional scientific knowledge developed by research during this period and by continuous safety evaluations of the project in the construction process. It may also be possible to utilize knowledge derived from the operating experience of other reactors—as is anticipated in the instant case (R. 705-706; see R. 669). At the construction permit stage, as Regulation 50.35 provides, the Commission necessarily reviews only a design concept and an approximation of the intended result ("a facility of the general type proposed"), whereas before licensing operation it reviews a definitive "final design."

The facts of modern scientific and technological progress also require that a definitive safety evaluation be postponed until the completion of construction and final testing. When a provisional construction permit is issued for a developmental reactor, the most that the Commission can do is to make a finding of reasonable assurance that a reactor of that type can be safely constructed and operated at the proposed site.[13] "Reasonable assurance," as used in this

[13] As the Commission noted in its opinion (R. 649), the technology of certain small research reactors is so well developed (they are "virtually production line items") that applicants have been able to supply complete hazards information in advance and the Commission issued them non-provisional permits containing a finding as to the safety of the particular design, "the reactor," not "the general type." See *e.g.*, *American Radiator and Standard Sanitary Corp.*, CPRR-50, 25 Fed. Reg. 1968. The Commission has recognized that such advance evaluation is the "ideal situation" but that it is not now possible for

context, is not speculation; it represents a substantial degree of certainty in a field which, by its very nature, is fraught with uncertainties. When the Commission makes a finding of reasonable assurance that a reactor of the particular type can be safely constructed and operated, it is in effect saying that, on the basis of the scientific and technological information then available, it appears reasonably likely that the technical problems that must be resolved before operating safety is assured will be resolved by the time construction is completed. As the Commission here pointed out (R. 672–673, emphasis in original), the "state of human knowledge at the time the report [of the Commission's Advisory Committee on Reactor Safeguards on the PRDC reactor] was prepared * * * permits the conclusion that going forward with the construction phase of this project would, by the very nature of the information developed in the course of evolving design, help to remove doubt concerning safety and would tend to provide an increasingly firm foundation for the reasonable assurance required by the statute that the project could be *operated* without undue risk to public health and safety." See also the testimony of Professor Bethe, quoted in the Commission's opinion (R. 673–674). Only when a reactor is completed, can the latest scientific and engineering knowledge be brought to

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any of the power reactors or for many of the other types. See *infra*, p. 64. This may be feasible when, eventually, power reactors are licensed as commercial facilities (Section 103), rather than as research and development projects (Section 104(b)).

bear upon the determination of the ultimate operating safety of the actual reactor that has been built. At that point the Commission will be in a much better position to evaluate the safety of a reactor than before construction has begun. Thus, the public is fully protected by postponing the final judgment upon safety, and development goes forward on the basis of reasonable assurance from the knowledge then available that particular problems can be solved during the development period, even though the precise form of the solutions cannot be foretold.

The process of testing and verifying design and operating techniques during construction, which involves "a sort of combined construction and research and development and necessary dovetailing of these things," is thus both basic to technological advances and also necessary for ultimate safety of operation (R. 73–74, 676). Maximum safety is provided, first, by the initial determinations made before construction under Regulation 50.35, which go far, at a time when complete safety specifications cannot be fixed in advance, to assure that the reactor being built will prove to be safe and that the Commission will be able to authorize its operation. Safety is then assured by the stringent scrutiny of the final design prior to actual licensing of its operation. At both construction and operating license stages, a public hearing is held at which "[t]here can be no doubt that public safety is the first, last, and a permanent consideration." (R. 646–647.)

C. THE ACT AUTHORIZES REGULATION 50.35 AND THE PRACTICE OF GRANTING PROVISIONAL CONSTRUCTION PERMITS UPON FINDING REASONABLE ASSURANCE THAT A REACTOR OF THE GENERAL TYPE PROPOSED CAN BE BUILT AND OPERATED SAFELY

1. *Regulation 50.35 conforms to the two-step procedure authorized by Section 185 of the Act.*— Nothing in the Atomic Energy Act of 1954 supports the court of appeals' ruling that the Commission "must" make the same safety findings "when it authorizes construction" as "when it authorizes operation" (R. 957).[14] On the contrary, the Act fully supports the distinction drawn in the Commission's regulations and followed in the instant case.

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[14] Although respondent unions contend (Br. in Opp. 11) that the court of appeals did not so hold, the opinion is to the contrary. The court stated (R. 957, emphasis in original):

"Petitioners contend that 'The Act) and the regulations of the Commission * * * require, as conditions precedent to the issuance of every construction permit for an atomic energy power reactor, that *as of the time the construction permit is issued* the Commission find that (1) it has reasonable assurance that the reactor may be constructed *and operated* at the proposed site without undue risk to the health and safety of the public * * *."

"It is undisputed that the Commission must make such a finding when it authorized operation. The question is whether it must make such a finding when it authorizes construction. In our opinion it must."

Similarly, the court then construed the legislative history (see *infra*, pp. 55, 61–62) as showing that "the Act * * * require[s], as a condition to the issuance of a construction permit, a finding that the proposed facility can be operated without undue risk to the health and safety of the public" (R. 960). This is the same finding required for an operating license, so that, in the court's view, a license must be issued "when the permitted construction is carried out" (R. 960).

Section 185 expressly provides for the issuance of construction permits and operating licenses, in two steps, and it obviously contemplates different standards for each step. The only condition imposed upon the grant of a construction permit is that the application be "otherwise acceptable to the Commission." In the case of the subsequent operating license, however, four conditions specified by Section 185 must be met (in addition to the conditions in Section 104), including a finding that the facility will be operated in conformity with the applicable statutory provisions and regulations, and the "absence of any good cause being shown to the Commission why the granting of a license would not be in accordance with the provisions of this Act." The latter standards were intended to assure that the statutory criteria for safe operation would be met before an operating license is issued. The absence of specific standards governing the grant of construction permits was evidently designed to give the Commission the broadest discretion in formulating appropriate safety standards at this stage of the proceeding.

It is also apparent from Section 185 that Congress knew that all the information necessary to make the final determinations prerequisite to a license would not be available when the construction permit was issued; and obviously, whenever this was true, a final determination concerning safety could not be made. The penultimate sentence speaks of "the filing of any additional information needed to bring the original application up to date."

The distinction is borne out by Section 182(a), which, after providing that all license applications shall contain specified information, further provides that "applications for licenses to operate production or utilization facilities" shall contain such information as the Commission may deem necessary to enable it to find that "the *utilization or production* of special nuclear material * * * will provide adequate protection to the health and safety of the public" (emphasis added). There is no "utilization or production" of special nuclear material during the course of construction. The reference is to the findings required by Sections 103 and 104 for the licensing of the operation of power reactors. Section 182(a) thus makes it explicit that this statutory safety standard must be satisfied before a license "to operate" may be issued. Had Congress intended in Section 185 to apply the same standard to the grant of a construction permit—which under that section merely gives authority "to construct or modify" (but, by definition, not to operate)—it would have said so.

The court of appeals' requirement that definitive safety findings be made when construction is authorized would seriously delay each new major developmental project (see R. 709), would discourage reactors incorporating "major advances" (like PRDC's, R. 702–704), which are given priority under Section 104(b), and would also lead to duplication of existing designs. It would thus thwart the progressive development of atomic power that Congress endeavored to further in the 1954 Act, without providing any demon-

strable benefits in terms of protection of public health and safety.

2. *Regulation 50.35 is a valid exercise of the rule-making power.*—The Atomic Energy Act of 1954, as we have shown above, delegates to the Commission the prime responsibility for public health and safety and gives it a broad rule-making authority. The key provision is Section 161(i), which authorizes the Commission to "prescribe such regulations or orders as it may deem necessary * * * (3) to govern any activity authorized pursuant to this Act * * * in order to protect health and to minimize danger to life or property." See also Section 161(b). Section 103, which contains the authority to issue commercial licenses, restricts their issuance to persons "who are equipped to observe and who agree to observe such safety standards to protect health and to minimize danger to life or property *as the Commission may by rule establish*" (Section 103(b), emphasis added). The developmental licensing provisions of Section 104(b) also speak of regulations to be imposed by the Commission to permit the Commission to protect the public health and safety. Section 104(d) prohibits the issuance of "a license" which the Commission finds would be inimical to the health or safety of the public.

We submit that it is plain, therefore, that even if the Act does not foreshadow, in Sections 182 and 185, the two-step findings concerning safety, it nevertheless authorizes the Commission to establish this procedure. Any doubt about the inferences concerning safety findings to be drawn from Sections 182 and 185 must be re-

solved in a manner consistent with the rule-making authority granted by Section 161, to which a reference is implicit in Sections 103 and 104, the key licensing provisions. See pp. 37–41, *supra*.

Regulation 50.35 is a reasonable exercise of this rule-making power. It advances the development, use and control of atomic energy, as desired by Congress (Section 1(a)) and also protects the health and safety of the public. See pp. 43–48, *supra*. The only attack upon it is the assertion that the Commission will be subjected to pressure to grant an operating license in order to save the financial investment, if it permits construction to proceed with less assurance of safety than would be required for operation. But the Commission is not concerned with the financial investment made by the applicant. The applicant takes the risk of inability to demonstrate that his reactor can operate with the high degree of safety required to protect the lives and safety of the public. In the present case, for example, the PRDC reactor could not have been licensed to operate at the time the construction permit was issued. Very serious safety problems remained unanswered. It is possible that the operation of the PRDC reactor will never be permitted because the prediction of ability to build a safe reactor of this type could not be fulfilled. The Commission made it abundantly clear in this case, as in others, that the construction permit carried no commitment to issue an operating license (R. 634–635, 649–650, 676, 679–680, 712, 716, 718–720). And the final determination upon safety must, and will be made, without regard to financial gain or loss.

The Atomic Energy Act of 1954 follows the well-established pattern of regulatory legislation which "define[s] broad areas for regulation and * * * establish[es] standards for judgment adequately related in their application to the problems to be solved" (*National Broadcasting Co.* v. *United States*, 319 U.S. 190, 220). Under such a statute, the agency's action must be sustained as long as it acts "within the statutory bounds of [its] authority, and * * * its choice among possible alternative standards adapted to the statutory end is one which a rational person could have made" (*Federal Security Administrator* v. *Quaker Oats Co.*, 318 U.S. 218, 233).[15] Deference is particularly due to an agency's judgment where it represents the "contemporaneous construction of a statute by the men charged with responsibility of setting its machinery in motion, of making the parts work efficiently and smoothly while they are yet un-

[15] This rule, of course, fully applies to regulation involving the public health and safety. See, *e.g.*, the leading case of *Jacobson* v. *Massachusetts*, 197 U.S. 11, 25-38, which upheld compulsory vaccination as a valid exercise of the state police power. Recent application of this principle is illustrated by a line of decisions in the state courts, which have uniformly held that under general authority to "provide," "promote," or "protect" the "public health," municipalities could lawfully decide to add fluorides to water supplies in order to prevent dental caries, despite the objection that fluorides were dangerous to health. This Court has consistently denied review. *E.g.*, *DeAryan* v. *Butler*, 119 Cal. App. 2d 674, 260 P. 2d 98, certiorari denied, 347 U.S. 1012; *Chapman* v. *Shreveport*, 225 La. 859, 74 So. 2d 142, appeal dismissed, 348 U.S. 892; *Kraus* v. *Cleveland*, 163 Ohio St. 559, 127 N.E. 2d 609, appeal dismissed, 351 U.S. 935. See Annotation, 43 A.L.R. 2d 453.

tried and new." *Norwegian Nitrogen Products Co.* v. *United States*, 288 U.S. 294, 315; *United States* v. *American Trucking Association*, 310 U.S. 534, 549; *Federal Housing Administration* v. *The Darlington, Inc.*, 358 U.S. 84, 90.

3. *The legislative history of the 1954 Act supports Regulation 50.35 and confirms the view that definitive safety findings are not required for the issuance of a construction permit.*—Under the view of the court of appeals that definitive safety findings are required for the issuance of a construction permit, it would follow, as the court stated (R. 960), that the Act "require[s] the issuance of a license when the permitted construction is carried out." The legislative history shows, however, that Congress rejected the latter requirement and, by necessary implication, recognized that, in the development of its reactor licensing program, the Commission might adopt the policy of deferring its definitive safety finding until it passes upon the operating license.

Section 185 imposes, as one of the conditions for the grant of an operating license, "the absence of any good cause being shown to the Commission why the granting of a license would not be in accordance with the provisions of this Act." The provision reserves to the Commission power to deny a license even though construction was carried out in accordance with the permit. This was a deliberate departure from the Communications Act of 1934, under which all definitive decisions with respect to the application

must be made when the agency issues a construction permit.[16] Certain industry spokesmen protested the "good cause" provision of Section 185 and vainly sought its deletion, urging that all "fundamental" determinations should precede construction, and that issuance of a license should be assured when construction is completed. Hearings on S. 3323 and H.R. 8862 before the Joint Committee on Atomic Energy, 83d Cong., 2d Sess., pp. 113, 117–119, 226–227, 417, 2 Leg. Hist. 1747, 1751–1753, 1860–1861, 2051. They recognized that "the terms of the construction-permit section would need a little amendment" to give this objective a specific statutory basis. Hearings, *id.*, p. 119, 2 Leg. Hist. 1753. Congress, however, rejected the proposal, and instead required a showing, prior to the grant of an operating license, of the absence of

[16] Compare the "good cause" provision of Section 185 with Section 319(c) of the Communications Act, 47 U.S.C. 319(c), which requires issuance of an operating license to the holder of a construction permit unless a "cause or circumstance arising or first coming to the knowledge of the Commission since the granting of the permit would * * * make the operation of such station against the public interest." Under that provision, an application for a permit is "in substance" an application for an operating license. *Ashbacker Radio Co.* v. *Federal Communications Commission*, 326 U.S. 327, 328 n. 1. Since the Communications Act was clearly the point of departure for the drafting of Section 185 (see Hearings on S. 3323 and H.R. 8862 before the Joint Committee on Atomic Energy, 83d Cong., 2d Sess., pp. 117–118, 2 Leg. Hist. 1751–1752; Marks & Trowbridge, *Framework for Atomic Industry*, p. 76 (1955); Green *The Law of Reactor Safety*, 12 Vanderbilt L. Rev. 115, 122), the different language used in the Atomic Energy Act shows the intent to authorize different standards for reactor construction permits and operating licenses.

"good cause" why the license should not issue—a standard that plainly embraces the statutory concept of adequate protection to the public health and safety. The Act thus contemplates some further safety determination before an operating license is issued; therefore it cannot be read to compel a definitive safety finding prior thereto, when the construction permit is granted.

When they are taken in their context, there is nothing contrary to our conclusion in the two items of legislative history invoked by the court of appeals as the basis for its decision.

(a) The principal item is a colloquy between Senators Humphrey and Hickenlooper, during which Senator Humphrey withdrew a proposed amendment of Section 185, which would have required that "no construction permits shall be issued by the Commission until after the completion of the procedures established by section 182 for the consideration of applications for licenses under this act." He did so upon being assured that "the revised sections on judicial review and on hearings and the revised section 182 on license application all apply directly to construction permits." R. 958–959; 100 Cong. Rec. 11566, 3 Leg. Hist. 3759. However, the context of this discussion, like the remainder of the debate in Congress over these sections, shows that it had nothing to do with the provision of Section 182(a) requiring a safety finding for operating licenses.

The colloquy was part of a protracted debate over the future economic pattern of the atomic industry,

involving such questions as the extent of participation by the federal government in atomic energy development, the role of local public bodies and cooperatives, the preferences to be given such bodies in licensing, the application of antitrust law and policy, and problems of rate regulation. The irrelevance of these economic issues to the safety provisions was shown in the dissent to the Joint Committee Report on the bill, which charged, *inter alia,* that the bill would turn "this greatest energy resource over to private power monopoly under licenses *unconditioned except for the requirements of national security and public health and safety.*" S. Rept. 1699, 83d Cong., 2d Sess., p. 121, 1 Leg. Hist. 869; H. Rept. 2181, 83d Cong., 2d Sess., p. 121, 1 Leg. Hist. 1117. [Emphasis added.] The provisions of the Act which dealt with public health and safety were never the subject of dispute or extensive discussion during Congressional consideration of the 1954 Act.[17]

During the discussion of these economic issues, opponents of the draft bill (including Senator Humphrey) urged a group of amendments, including the foregoing proposed amendment to Section 185 impos-

[17] The safety standard for operating licenses in Section 182(a) remained unchanged throughout the legislative consideration of the 1954 Act, and was not the subject of debate. Compare Sections 182 and 189 in the bill reported to the floor (S. 3690, H.R. 9757, 83d Cong., 2d Sess., 1 Leg. Hist. 729–731, 735, 977–979, 983) with the bill as enacted. The present subsections 182 (c), (d) were originally numbered 182 (b), (c), until a 1957 amendment, 71 Stat. 576.

ing the licensing procedures of Section 182 upon the construction permit procedures in Section 185.[15] On the Senate floor, the opposition achieved specific revisions in the bill, now contained in Sections 182 (c) and (d) and 189, which require that notice of hearing on applications for construction permits be given to municipalities, public bodies and cooperatives, provide them with the right to judicial review in such proceedings, and guarantee them certain preferences in licensing. Senator Humphrey's objective, as explicitly stated in the quoted colloquy, was to insure that the *"revised"* Sections 182 and 189—*i.e.*, these procedures and economic objectives (see n. 17)—should be applicable to construction permits.

The same point was explicitly made by the original proponent of the amendment to Section 185 in the House, Representative Holifield, who expressly stated that the amendment "follows through" on the other proposed amendments, requiring notice to municipalities, public bodies and cooperatives, public hearings, and preferences. These "procedures" were to be made applicable to construction permits. 100 Cong. Rec. 10397, 10398, 3 Leg. Hist. 2848, 2849; S. Rept.

[15] For the proposed amendments, see the dissent to Joint Committee Report on the bill, S. Rept. 1699, 83d Cong., 2d Sess., pp. 122–123, 1 Leg. Hist. 870–871; H. Rept. 2181, 83d Cong., 2d Sess. pp. 122–123, 1 Leg. Hist. 1118–1119; 100 Cong. Rec. 10397–10398, 3 Leg. Hist. 2848–2849 (proposed in House); 3 Leg. Hist. x–xi (proposed in Senate).

1699, 83d Cong., 2d Sess., p. 123, 1 Leg. Hist. 871.[19] For a similar comment on the Senate floor, see 100 Cong. Rec. 11157; 3 Leg. Hist. 3528. And in the colloquy partially quoted by the court of appeals, and thereafter, Senator Humphrey himself emphasized the proposed amendment's effect in assuring notice and preferences. 100 Cong. Rec. [redacted] 11754, 3 Leg. Hist. 3759, 3877.[20]

In short, Senator Humphrey's proposed amendment to Section 185 was designed solely to insure that the notice, hearing and appellate procedures theretofore applicable to the grant of operating licenses would be extended to construction permit proceedings. The revisions in the Act that caused him to withdraw his amendment were designed to, and did, accomplish only those procedural changes (as well as changes in the preferences given to certain municipal and public bodies). They did not purport

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[19] In the dissent from the Joint Committee report on the draft bill, Representatives Price and Holifield had urged that issuance of construction permits under Section 185 "should be specifically subject to the same *procedural safeguards*, assuring interested parties full opportunity for notice, hearing, and appeal before issuance, as are provided in connection with the issuance of licenses under section 182." S. Rept. 1699, 83d Cong., 2d Sess., p. 123, 1 Leg. Hist. 871; H. Rept. 2181, 83d Cong., 2d Sess., p. 123, 1 Leg. Hist. 1119 [emphasis added]

[20] In this context, Senator Humphrey's reference to "pressure" for issuance of an operating license after construction (quoted R. 958–959) related to possible foreclosing of the choice of licensee unless notice, hearing, preference and appeal were available at the construction permit stage.

to, and did not, change the statutory provisions governing the health and safety findings required for construction permits—provisions which, as we have previously shown, fully justify the Commission's grant of provisional construction permits upon findings of reasonable assurance that the proposed type of reactor can be constructed and operated consistent with the public health and safety. Read in context, the statement by Senator Humphrey, which the court below stressed (R. 959), that "under the terms of the bill, as amended, the construction permit is equivalent to a license," meant only that it was "equivalent to a license" in terms of the procedures to be followed in its issuance. His mind was not directed to matters of safety and his remarks cannot fairly be construed as suggesting that the health and safety findings required for operating licenses by Section 182 were being made applicable to the grant of construction permits under Section 185.

(b) The court also relied (R. 960) on the statement in the Joint Atomic Energy Committee report on the bill that Section 185 "requires the issuance of a license if the construction is carried out in accordance with the terms of the construction permit." But, as we have shown (*supra*, pp. 37, 50), this is only one of the conditions prescribed in Section 185 for the granting of an operating license, and Congress rejected a proposal for routine issuance of operating licenses whenever construction is carried out in accordance with the permit (see *supra*, pp. 55–57). Other conditions of Section 185 clearly "require"

the Commission also to make other findings before issuing an operating license, including a finding that the facility will operate safely "in conformity with" the statutory provisions and regulations and that there is not countervailing "good cause shown." Moreover, one of the terms of every construction permit for a reactor, including this one, which must be satisfied before an operating license is granted, is that the Commission be enabled to find that the reactor is built in such a way that its operation will not endanger "the health and safety of the public" (R. 718).

4. *The acquiescence of Congress confirms Regulation 50.35 and the Commission's practice thereunder.*—Any doubt concerning the correctness of our interpretation of the statute should be removed by the Commission's frequent reports to the Joint Congressional Committee on Atomic Energy and the Committee's apparent acquiescence in the practice of issuing provisional construction permits without making definitive safety findings. The Joint Committee has a special relationship to the Commission. It exercises jurisdiction over all bills dealing with the atomic energy program. The Atomic Energy Act further requires the Commission to "keep the Joint Committee fully and currently informed with respect to all of the Commission's activities" and explicitly directs the Joint Committee to "make continuing studies of the activities of the Atomic Energy Commission and of problems relating to the development, use, and control of atomic energy," and to conduct hearings at the start of each

Congressional session on the "development, growth, and state of the atomic energy industry." Section 202, *infra*, pp. 129–130.[21] The Commission thus keeps "on close terms with its committees, reporting to the Congress, airing its problems before them, looking to Congress for guidance and directions" (*Panama Canal Co.* v. *Grace Line, Inc.*, 356 U.S. 309, 318–319).

Pursuant to these statutory provisions, the Commission has repeatedly advised the Congress of the practice of issuing provisional construction permits, and the reasons behind it. In 1956, before the Commission's regulations were promulgated, the Director of the Division of Civilian Application (now Director, Division of Licensing and Regulation) described this practice as follows:

> What we have done is to set up a procedurre under which applicants can make their preliminary submissions to the Commission and then we would, so to speak, work along with them as fast as we are satisfied that the general design concept and the location of the facility

[21] Congressional action up to December 1959 is compiled in Joint Committee on Atomic Energy, Atomic Energy Legislation through 86th Congress, 1st Session (Joint Committee Print, 1960), pp. 81–141, 195–205. In addition to statutory hearings and other communications, the Act provides for a general annual report of the Commission's activities, and annual report on the operation of indemnification of liability for nuclear incidents, and on any such incidents (Sections 170(i), 251, 42 U.S.C. 2210(i), 2016) and that certain decisions of the Commission must sit before the Committee for specified periods before they may become effective. Sections 51, 58, 61, 123 (c), (d), 42 U.S.C. 2071, 2078, 2091, 2153 (c), (d).

> appear to be all right. We would go ahead and issue a construction permit as the statute permits, which would have to be conditional, of course, conditioned upon their satisfying the various hazards problems that they will have to deal with. * * * [I]t is pretty clear that all of those matters will not finally be resolved until about the time the reactor is going into operation, because their designs will change, and they will run tests.

(R. 652–653); Hearings on Development, Growth, and State of the Atomic Energy Industry before the Joint Committee on Atomic Energy (1956), 84th Congress, 2d Sess., p. 106). The reason for this procedure was the "substantially unique" nature of each power reactor and the technical problems which could only be resolved "on a case-by-case basis." R. 652, 654; Hearings, *id.*, pp. 106, 133.

Three months later, the Commission's General Manager told the Joint Committee that in the "ideal situation" all hazards information would be available, and evaluated, before issuance of a construction permit. "Such ideal conditions, of course, do not exist today." For that reason, to cope with "experimentation and development," the Commission's regulations allow for "provisional construction permits." The General Manager emphasized the strict safety finding required before conversion to an operating license and pointed out: "This is the type of construction permit that we will probably have to issue for all of the power demonstration reactors, and even for many of the research, testing, and medical reactors, for the

next few years." Hearings on Governmental Indemnity before the Joint Committee on Atomic Energy, 84th Cong., 2d Sess., pp. 62–65.

In 1958, the same approach was re-emphasized to the Joint Committee by the Chairman of the Commission's Advisory Committee on Reactor Safeguards. Because each large reactor is a "new type," "it is impossible to give a construction permit which then can be guaranteed to be converted into an operating license," despite the applicant's desire for such arrangement. The solution, he said, was to issue "conditional" permits and examine the developing design "step by step and keep informed each step of the way." The Vice Chairman of the Advisory Committee pointed out that safety evaluation is developed during construction and that "in general these large plants take so long a time to be constructed that much of the safety requirements are met well within the projected area of time." R. 656–658; Hearings on Development, Growth, and State of the Atomic Energy Industry before the Joint Committee on Atomic Energy (1958), 85th Cong., 2d Sess., pp. 119–121, 123; see also Hearings on Operation of AEC Indemnity Act before the Joint Committee on Atomic Energy, 85th Cong., 2d Sess., pp. 56–57.

During this same period of "subsequent and continuing action by the Congress" (*Ivanhoe Irrigation District* v. *McCracken*, 357 U.S. 275, 293), the Joint Committee in 1956–1957 specifically studied the Commission's reactor licensing program, including the provisional construction permit procedure. As a re-

sult, it recommended, and Congress enacted, certain changes in that program (not here involved); it did not, however, recommend any change in the Commission's practice of issuing construction permits without making definitive safety findings. 71 Stat. 576; Joint Committee on Atomic Energy, *A Study of AEC Procedures and Organization in the Licensing of Reactor Facilities*, 85th Cong., 1st Sess. (Joint Committee Print 1957).

This history of the relationship between the Commission and the Joint Committee, with full explanation of the Commission's provisional construction permit procedure, may be viewed as confirmatory of the Commission's original understanding of its powers under the Act, as affirmative Congressional acquiescence in that view, or even as Congressional "ratification of administrative construction." See *McCracken, supra; Panama Canal Co.* v. *Grace Line, Inc.*, 356 U.S. 309, 318–319; *Brooks* v. *Dewar*, 313 U.S. 354, 361. But however it is viewed, it further supports the validity of the Commission's provisional construction permit regulations.

D. THE COMMISSION'S FINDINGS COMPLY WITH THE REGULATIONS AND ARE SUPPORTED BY SUBSTANTIAL EVIDENCE

Before reaffirming the construction permit, the Commission made two ultimate findings concerning safety. In Finding 35 it concluded (R. 711)

> The issuance of a provisional construction permit to the Applicant will not be inimical * * * to the health and safety of the public.

This finding uses the exact words of Section 104(d) except for the substitution of "construction permit" for "license." Manifestly, it satisfies any requirement of Section 104(d) which could be thought pertinent to the issuance of a permit.

In Finding 22 the Commission concluded (R. 708):

> The Commission finds reasonable assurance in the record, *for the purposes of this provisional construction permit,* that a utilization facility of the general type proposed in the PRDC Application and amendments thereto can be constructed and operated at the location without undue risk to the health and safety of the public. [Italics supplied.]

This finding not only satisfies the substance, but uses the very words of Regulation 50.35. The only divergence is the addition of the italicized phrase, "for the purposes of this provisional construction permit."

The court below thought that the use of this italicized phrase in Finding 22 and elsewhere in the Commission's Opinion, Final Decision and Order (*e.g.*, R. 676, 710) denigrated the finding to the point where it did not meet the standard required on the other occasions and prescribed by the Act (R. 961–965). Insofar as this was simply another way of saying that the Commission did not make the findings required for the issuance of an operating license, we acknowledge that the characterization of the finding is accurate but submit that it does not invalidate the construction permit because the higher degree of assurance is not required. See pp. 49–66, *supra*. Insofar as it rules

that the findings in this case do not satisfy Regulation 50.35 or conform to the findings made in connection with other construction permits, we submit that the court's conclusion is plainly wrong.

The reference to the "purposes of this provisional construction permit" was not intended to, and did not, derogate in any way from the basic finding, reiterated several times without the reference (R. 665, 676–677, 710–711), that there was reasonable assurance that a reactor of this general type could be operated at this site without undue risk to the public health and safety. The phrase served two purposes. One was to reemphasize, and make it particularly explicit in this, the Commission's first contested reactor construction licensing case, that the grant of the construction permit was not to be taken as any indication that the safety findings then made would lead to an operating license. The italicized phrase also underscored the Commission ruling that the issuance of a provisional construction permit required no more than the finding set forth in Regulation 50.35. The following statement in the Commission's opinion (R. 676–677) shows that this interpretation of the finding is plainly correct:

> It is enough for the purposes of the present proceeding (that is, for the issuance of a provisional construction permit), and for the satisfaction of the requirements of the statute and the regulations, that there be reasonable assurance that the reactor can be constructed and operated without undue risk to the health and safety of the public.

Here the phrase "for the purposes of [this] proceeding" cannot possibly be read to limit the substantive content of the finding. It obviously serves only the above-stated purposes.

Indeed, whenever the Commission finds, in issuing a construction permit, that there is a reasonable assurance that a facility of the type proposed can be operated consistent with the public health and safety, such finding necessarily is made for the purposes of the particular construction permit involved. Under the Commission's regulations (Sections 50.35, 50.40, *infra*, pp. 135–136), another safety finding relating to the particular reactor's "final design" (as distinguished from the "general type" proposed) will be required before an operating license will be issued. Here the Commission repeatedly so stated in its decision. Accordingly, the use in this case of the phrase "for the purposes of this provisional construction permit" merely made explicit what is inherent in every grant of a construction permit—and did nothing more.

The court of appeals also held (R. 963) that "the Commission's findings regarding safety of operation are ambiguous," because of the Commission's "repeated expressions of uncertainty" on the one hand, and its "positive opinion regarding safety of operation" on the other (R. 963). This alleged ambiguity, however, involves no more than the distinction, clearly drawn in the regulations, between the two types of findings made by the Commission in granting a construction permit for a developmental reactor: a present conclusion (the "positive opinion") as to the

safety of the general type of reactor proposed, and a tentative conclusion (the alleged "expressions of uncertainty") as to the eventual demonstration of the safety of the "final design" in the light of the applicant's research and development program. The court did not refer to Regulations 50.35 and 50.40, and we submit that when the findings are examined in the light thereof, they are not ambiguous but merely reflect the different standards there established for the grant of construction permits and operating licenses. The Commission has never contended that the PRDC reactor has been proved safe enough for a license to operate.[22]

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[22] The court below also suggested that the Commission changed its view as to the degree of reasonable assurance it was finding in its initial and final decision. It relied, in addition to the insertion of the phrase "for the purposes of this provisional construction permit", in the final decision, on the statement in the final decision (R. 679, emphasis in original) that a different "degree of 'reasonable assurance'" is required to satisfy the Commission "for purposes of the *provisional* construction permit" than "we would require in considering the issuance of the *operating* license." But the Commission made substantially the same statement in the initial decision (R. 934): "[W]e emphasize that the degree of certitude that satisfies us for purposes of the provisional construction permit would not be the same as we would require if we were at this moment considering the issuance of the operating license. 'Reasonable assurance' can be a different standard for the one purpose from what it is for the other." These statements merely articulated what is implicit in Regulation 50.35, namely, that different standards will be applied in reviewing (1) the general type of facility proposed, preliminary to granting a construction permit, and (2) the actual completed reactor, prior to authorizing its operation. Indeed, it is because of these

The ultimate findings quoted above rest upon a number of subsidiary findings covering the various factors relevant to the over-all evaluation of the effect of a reactor of the type proposed upon the public health and safety. According to the Commission's opinion, there are three major problems relating to the operational safety of a fast breeder reactor (R. 669–670). First, there is the possibility that such a reactor might have autocatalytic or resonance instabilities leading to a nuclear runaway. Second, there is a possibility that a fuel meltdown resulting from the nuclear runaway or a failure of the coolant could release energies capable of breaching the various layers provided for containing radioactive fission products. Third, the leak of radioactive fission products in the event of such breaching might cause damage to members of the public. The Commission had before it a report of the Advisory Committee on Reactor Safety which concluded that as of June 6, 1956, sufficient information was not available to give assurance that the PRDC reactor could be operated at Lagoona Beach without public hazard and that it was doubtful whether sufficient experimental information would be available in time to give this assurance before construction would be completed (R. 672–673, n. 59). Under the first condition the Commission could not

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different standards, based on the impossibility of making a definitive safety determination when construction is authorized, that the Commission has adopted the two-step procedure governing the granting of provisional construction permits and operating licenses. See *supra*, pp. 42–48.

properly, and would not, issue a license to operate the reactor. And an operating license could not be issued until the problems were solved.

The Commission then went on to examine the likelihood that the safety problems would be overcome. It concluded that the instabilities which could lead to a nuclear runaway were "capable of handling by design features" (R. 671), and found that the expert testimony on the safety of the PRDC design "permits the conclusion that going forward with the construction phase of this project would, by the very nature of the information developed in the course of evolving design, help to remove doubt concerning safety and would tend to provide an increasingly firm foundation for the reasonable assurance required by the statute that the project could be *operated* without undue risk to public health and safety" (R. 672–673). Since there is no "inherent hazard" in the construction and operation of fast neutron breeder reactors (R. 676, 703), there was reasonable assurance that the problem of instabilities would be overcome by the theoretical and experimental investigations which were being undertaken, together with the operating experience on other reactors. Summarizing its study of the safety problems, the Commission said (R. 676):

> Based on this record, there is nothing in the PRDC design as presently contemplated that is known to be inherently and immediately dangerous, no insoluble problems are presently identified, and construction of a prototype is not required because of the experimental work

being done or to be done on problems affecting a fast breeder reactor of the PRDC type. However, until the questions raised by the ACRS have been answered to the satisfaction of the Commission, there will be no license to operate the PRDC reactor.

The Commission (R. 677) also made subsidiary findings concerning the location of the plant because "the question of safety obviously cannot be considered without regard to proposed location." The Commission found that the site is bordered on one side by water, that it provides an "exclusion area" on the land side with a minimum radius of 2,900 feet, and that the population distribution ranged from 175 one mile from the site, 600 two miles from the site, and 1,800 five miles from the site, up to 2,001,700 thirty miles away (R. 706–707). It pointed out that the dangers were minimized by a containment shell and that "the likelihood of any breach of the containment shell which PRDC proposes, designed as it is to contain an explosive which is equivalent to 600 pounds of TNT, a limit beyond any known accident possibility in the reactor, is extremely remote" (R. 677). The evidence also satisfied the Commission that the site "makes possible extensive safeguards against the inadvertent release of liquid contaminants" (R. 678); that it is "satisfactory from structural and underground water flow standpoints"; and that its meteorology, although complex, is not disqualifying (R. 678).

The Commission expressly reserved jurisdiction to reopen the proceeding, at any time prior to the issuance of an operating license, for further evidence and for consideration of data pertinent to safety (R. 714, 718). It also confirmed the procedure established in its initial decision "for continuing review of the safety characteristics of the PRDC fast breeder nuclear reactor plant," under which PRDC and the Commission staff were directed, and respondent unions were permitted, to file with the Commission "data pertinent to the safety in construction, design, and operating characteristics of fast breeder nuclear reactors similar or identical to PRDC project so as to permit review by the Commission * * *" (R. 711-714).[23] Finally, the Commission, although finding that no necessity had been shown for construction of a "prototype of the proposed reactor at a remote location," stated that it would reconsider that question "[i]f the program of meltdown investigation should prove inconclusive * * *" (R. 676, 705–706), *i.e.*, if it should not clearly negate a possible melting down of the nuclear fuel that could result in the release of substantial energy.

The subordinate findings as well as the Commission's ultimate conclusions on public health and safety rest upon voluminous evidence dealing with all aspects of the proposed reactor. The record includes substantial information related to PRDC's technical and financial qualifications to build and operate the fa-

[23] Such data have been filed (R. 632–634).

cility; testimony and reports on the reactor's preliminary design; discussion of fast nuclear reactors in general, including the characteristics of, and experience with, prior and proposed reactors of this type; analysis of potential hazards, and of safeguards therefor in the design of the PRDC plant; and reports on the possible effect of hypothetical incidents in a plant at Lagoona Beach, Michigan, in view of site conditions there. Since respondent unions did not challenge the evidentiary basis for the Commission's findings on public health and safety in the court below (see R. 951–953), they should not be permitted to raise the question here.

II

THE COMMISSION IS NOT REQUIRED TO MAKE AN EXPRESS FINDING SHOWING "COMPELLING REASONS" BEFORE APPROVING THE LOCATION OF A REACTOR NEAR A POPULATED AREA

The court of appeals held (R. 964) that the "Commission's safety findings are deficient in an additional respect," namely, that although "Congress intended that no reactor should, without compelling reasons, be located where it will expose so large a population to the possibility of a nuclear disaster [, i]t does not appear [that] the Commission found compelling reasons or saw that such reasons were necessary." Neither the language nor the legislative history of the Act justifies the court's "compelling reasons" standard.[*] Both support the Commission's settled practice

[*] The court of appeals' standard is not only without any basis in the statute, but also is so vague that it would be extremely difficult for the agency to administer. There is no indication

of treating the site as one of the many factors upon which its over-all ultimate judgment as to operating safety is based. Furthermore, the court's statement that the location of the PRDC reactor approximately 30 miles from Detroit will "expose" a large "population to the possibility of a nuclear disaster" has no support in, and is contradicted by, both the Commission's findings and the evidence upon which they rest.

1. The operating license for a reactor such as the PRDC plant would be issued under Section 104; the construction permit under Section 185. The only statutory test concerning safety which Congress established as prerequisite to the issuance of even an operating license is a general finding of adequate protection to the health and safety of the public. Thus, Section 104(d) provides:

> In any event, no license may be issued * * * if, in the opinion of the Commission, the issuance of a license to such person would be inimical to * * * the health or safety of the public.

And Section 182(a), dealing with the contents of an application for an operating license, requires, *inter alia*:

> Such * * * information as the Commission may * * * deem necessary in order to enable it to find that the utilization or production of special

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what population would be deemed "so large" as to make the principle operative, or what reasons—of technology, economics or national security—might be considered "compelling." Furthermore, such an unclear standard will inevitably engender further controversy over the location of future large-scale power reactors.

> nuclear material * * * will provide adequate protection to the health and safety of the public.

The statutory finding requires the evaluation of many factors. They include (1) the degree of probability as to each conceivable accident in the operation of the reactor; (2) the degree of probability, if any, that radioactive materials will escape each of the successive barriers if an accident occurs; (3) the volume and lifetime of any radioactive materials which could conceivably escape; (4) the direction and distances which they might travel; (5) the character and amount of harm which they could do; (6) the gains from the proposed method of construction and operation; (7) the advantages of the location; and (8) the number of the people and value of the property which could conceivably be affected. The evaluation of each of these factors and the balancing of advantages against disadvantages is the task of the fact-finder. Assuming *arguendo* that it would be proper for a court to reverse the Commission if it failed to consider a relevant factor such as the nearness of a population center, the weight to be given that factor is for the Commission to determine in making the ultimate finding required by the statute. The Commission's finding is final unless it is arbitrary or capricious. *Interstate Commerce Commission* v. *Parker*, 326 U.S. 60; *United States* v. *Detroit & Cleveland Navigation Co.*, 326 U.S. 236, 241; *United States* v. *Storer Broadcasting Co.*, 351 U.S. 192, 203. The findings are not challenged here.

The error of the majority of the court of appeals lay in requiring a special subordinate finding of "compelling reasons" for locating a power reactor in a populated area. The short answer is that the statute requires none. Nor does the statute commit questions concerning plant location to the courts.

On the contrary the statute explicitly delegates to the Commission the responsibility for plant location. Section 161(i)(3) authorizes the Commission—

> to prescribe such regulations or orders as it may deem necessary * * * to govern any activity authorized pursuant to this Act, including standards and restrictions governing the * * * location * * * of facilities used in the conduct of such activity, in order to protect health and to minimize danger to life or property.

Section 182(a) lists "the place of use" as one of the items of information which must be submitted with an application in order that the Commission may determine whether there will be "adequate protection" for the public health and safety.

Pursuant to these provisions the Commission issued Regulation 50.34, which specifically requires description of the site and surrounding uses, sources of water supplies and public utilities, and pertinent meteorological, hydrological, geological and seismological data. Certain adverse site characteristics, like earthquake experience, may indicate a possible source of accidents. In addition, the effect of an incident which released fission products would depend upon

conditions at the site—particularly, meteorology and population density (R. 678, 877–878, 882, 890).

In the present case the Commission gave careful attention to the proposed location. It noted its geology, hydrology and meteorology as then ascertained and observed that further information was being developed (R. 678). Both the Initial and Final Decision explicitly take account of the density of the surrounding population (R. 614, 677–678). Both observed that "the question of safety obviously cannot be considered without regard to proposed location" (R. 677; compare R. 614), and in the Final Decision the Commission found (R. 710–711):

> There is reasonable assurance that the proposed site is generally suitable for a reactor of the type and size described in the Application, if the reactor is otherwise shown to be capable of operation without undue risk to the public health and safety, including demonstrations of stability and adequate containment. Adequate investigations are under way to establish the characteristics of the proposed site, including all relevant aspects with respect thereto.

The Commission's ultimate finding upon safety also took account of the location. It found (R. 708)

> reasonable assurance * * * that a utilization facility of the general type proposed in the PRDC Application and amendments thereto can be constructed and operated *at the location* without undue risk to the health and safety of the public. [Emphasis added.]

Respondents do not attack these findings and, in any event, there is substantial evidence to support them. Professor Hans Bethe (R. 779) stated that

> a fast breeder reactor of the general type proposed by PRDC can be constructed and operated in a populated community without undue risk to the public, and that it can be demonstrated, when such reactor has been built, that its operation is safe.

Another expert, Professor Harvey Brooks of Harvard, a member of the Commission's Advisory Committee on Reactor Safeguards, testified (R. 674–675):

> * * * I believe that in all probability a fast breeder reactor of the PRDC design can be operated in a populous location such as the proposed Lagoona Beach site without undue hazard to the health and safety of the public.

See also the statements to the same effect of Dr. Hilberry, Deputy Director of the Argonne Laboratory (R. 818), Mr. Davis, Director of the Commission's Division of Reactor Development (R. 853–854), and Professor Benedict of Massachusetts Institute of Technology (R. 674). Behind these general statements by expert witnesses lies a mass of technical data.

2. The court of appeals' statement that the proposed location "will expose so large a population to the possibility of a nuclear disaster" (R. 964) not only usurps the Commission's function of finding and evaluating the facts but it flies in the face of the undisputed testimony. This would be error in any proceeding to

review the order of an administrative agency. *Federal Trade Commission* v. *Algoma Lumber Co.*, 291 U.S. 67, 73. The error is especially serious where judges not trained in complicated scientific and technical matters undertake to substitute their conclusions for the findings of the expert body established by Congress. *Secretary of Agriculture* v. *Central Roig Refining Co.*, 338 U.S. 604, 614; *Federal Trade Commission* v. *Sewell*, 353 U.S. 969.

It is obvious, of course, that when all other conditions are the same, a power reactor located near a city creates a greater risk of harm than the identical plant located in the wilderness. If there were no offsetting advantages, it might be desirable to put the reactor in the wilderness even though the chance that harm would occur was infinitesimally small. But in the present case there were offsetting advantages in the site for the Commission to consider—advantages which, in view of the high degree of engineering safeguards that this reactor will have (see *supra*, pp. 13, 16), justified the Commission's approval of the reactor at this location.

While the Commission did not specifically discuss these offsetting advantages, they were the implicit framework within which its decision was made. For Congress made the determination, by deciding that atomic power should be developed by and as part of American industry, that there were significant benefits to the country in permitting the Commission to approve reactor locations near metropolitan areas. See *supra*, pp. 35–36, *infra*, pp. 85–87. In the present case,

the advantages of a location within reasonable distance of Detroit are substantial.

(a) The very purpose of the proposed reactor was to develop a nuclear power plant capable of economically generating electric energy as a part of a public utility system. The Commission and PRDC were not engaged in pure research but in the economical development of operating generating stations using atomic energy. In contrast, the Commission's fast breeder reactors EBR–I and EBR–II (see n. 10, *supra*, p. 19) are flexible experimental facilities which will supply a wealth of scientific data concerning reactor operation. The PRDC reactor is not experimental in this sense, although it has certain novel features. However, it is primarily a prototype for central power stations to be based on proven technology before it is licensed to operate. It is intended to demonstrate the reliability and economic utility of an atomic power plant under normal operating conditions, as a large baseload plant in a power grid with varying demands, and to furnish information on the economics and maintenance of such a plant in routine use (R. 809–815, 839–841). Much of the PRDC plant's value for this essential research and development would be lost by locating it in the wilderness.

(b) The reactor will supply electric energy in the Detroit area if an operating license can be issued safely.

(c) Pursuant to a well-defined Congressional policy, adopted after careful deliberation, the Commission seeks to foster progress in atomic power development

by encouraging the widespread participation of public utilities and industrial concerns in the development and use of atomic energy. This was one of the basic purposes of the Atomic Energy Act of 1954.[25] Effective participation by utilities, however, may be impossible if large power reactors must be located in remote areas of the country and cannot be placed in the utilities' service areas or within a reasonable distance, to provide feasible service to the utilities' metropolitan and industrial consumers.

We do not overlook the fact that although these considerations may be reasons for licensing a reactor in a populated area, the proximity of the population demands a higher degree of safety. The Commission acknowledged this, and took it into account in the findings. See pp. 73, 79–80, *supra*. The statute requires no more.

3. The Commission's procedure in this case followed the same course as all other applications to license the construction or operation of a reactor. Construction permits have not been issued by the Commission for developmental power reactors without full consideration of all the pertinent criteria of safety of operation *at the proposed site*, but the Commission has never made a special finding that there were "compelling reasons" for locating the reactor site not far from a

[25] See Sections 1(b), 3 (a), (d), 182 (c), (d), 42 U.S.C. 2011, 2013 (a), (d), 2232 (c), (d). H. Doc. 328, 83d Cong., 2d Sess., pp. 6–7; 1 Leg. Hist. 50–51; S. Rept. 1699, 83d Cong., 2d Sess., pp. 3, 9, 1 Leg. Hist. 751, 757; H. Rept. 2181, 83d Cong., 2d Sess., pp. 3, 9, 1 Leg. Hist. 999, 1005; pp. 35–36, *supra*.

populated area.[26] In determining whether a particular reactor should be approved, the Commission considers and evaluates all the factors, including location, that bear upon operating safety. A prime consideration, of course, is the facility itself, starting with the reactor type, power level, control and safety devices, shielding and containment—in short, all aspects of design features and operating procedures pertinent to the stability of the reactor, and the avoidance of hazards. The Commission, even if satisfied that the design of the reactor satisfies safety standards, may nevertheless find that site characteristics are so unfavorable as to require relocation or abandonment of projects, as has occurred on several occasions; population densities immediately adjacent are significant in this determination.[27] However, location 30 miles from a large center

[26] A listing of power reactors now operating or being constructed by licensees and the Commission, and distances from nearby population centers, is set out in Appendix B, *infra*, pp. 137–139. The Commission's criteria for power reactor sites are exemplified by those cases and has been often discussed at Congressional hearings, *e.g.*, the material cited, *infra*, n. 27, and pp. 85–89. A proposed formal rule, embodying the Commission's criteria and *inter alia* pointing out the relation of population density outside an "exclusion area" to other factors, was published in 24 F.R. 4184. Comments have been received, and a revised rule is now in preparation to be published for public comment.

[27] See, *e.g.*, *City of Piqua, Ohio*, A.E.C. Docket No. PP-2 (adjacent population density); Point LOMA Process Heat Reactor, Report of Advisory Committee on Reactor Safeguards, March 14, 1960 (AEC Public Document Room) (unfavorable meteorology, adjacent population density, other local uses). Cf. Hearings on Indemnity and Reactor Safety before the Joint Committee on Atomic Energy, 86th Cong., 2d Sess., pp. 247–250.

of population has never been considered disqualifying *per se*, although it would be particularly pertinent to appraisal of the consequences of an incident causing a substantial release of fission products under extremely adverse meteorological conditions (R. 877). In view of the location, the Commission may require certain additional design features or impose conditions upon operation—as, indeed, it may do in this case before authorizing operation. Even if the Commission is satisfied that the reactor will operate safely, its location near a populated area demands that the reactor be enclosed in a steel vapor shell designed to contain all fission products that could be released by the maximum credible accident (R. 743, 882). Cf. Hearings before the Joint Committee on Atomic Energy on Indemnity and Reactor Safety, 86th Cong., 2d Sess., pp. 200–204; on Governmental Indemnity and Reactor Safety, 85th Cong., 1st Sess., pp. 54–55 (n. 30, *infra*). Such a shell will, of course, be required for the PRDC reactor (R. 666–667).

4. The Commission's policy on reactor location is explicitly validated by the legislative history of the Act. In the first place, Congress contemplated that the safety regulation it was committing to the Commission's discretion included supervision of the location of reactors. Review of such sites was mentioned as an important aspect of issuing construction permits during the 1954 hearings. Hearings on S. 3323 and H.R. 8862 before the Joint Committee on Atomic Energy, 83d Cong., 2d Sess., p. 118, 2 Leg. Hist. 1752. Moreover, Congress understood that, under the

licensing program, many power reactors (like new conventional generating facilities) would be constructed and operated "near but not in" the power-consuming "metropolitan and industrial centers." Hearings, *supra*, p. 582, 2 Leg. Hist. 2220. The use of such locations was implicit in the President's desire to have the industry develop "in a manner as nearly normal as possible, with careful regulation to protect the national security and the public health and safety" (H. Doc. 328, 83d Cong., 2d Sess., pp. 6–7, 1 Leg. Hist. 50–51). Location near industrial areas is necessary to carry out the clear legislative intent to chart a course for atomic power reactors as "an integral part of the electric-generating activities of the country" (Hearings, *supra*, p. 582, 1 Leg. Hist. 2220).

Congress also understood, and anticipated, that reactors would be located near metropolitan centers during the developmental stage of atomic power. There were repeated references to the Commission's Shippingport Pressurized Water Reactor, then being constructed about 30 miles from the center of Pittsburgh—"the Nation's first large-scale atomic-power reactor, which will generate 60,000 kilowatts of electricity—an amount sufficient to furnish light and power for a sizable city." S. Rep. 1699, 83d Cong., 2d Sess., p. 3, 1 Leg. Hist. 751; H. Rep. 2181, 83d Cong., 2d Sess., p. 3, 1 Leg. Hist. 999. And Senator Kennedy testified in favor of the location of "pilot plant activity" and "experimental plants" in New England, where eventual commercial feasibility could

be anticipated. Hearings, *supra*, pp. 774–780, 2 Leg. Hist. 2412–2418. See, also, as to New York State, 100 Cong. Rec. 10910, 3 Leg. Hist. 3461.[20] Congress was confident that, by giving the Commission broad discretion to formulate a safety program, "greater private participation in power development need not bring with it attendant hazards to the health and safety of the American people." S. Rep. 1699, 83d Cong., 2d Sess., p. 3, 1 Leg. Hist. 751; H. Rep. 2181, 83d Cong., 2d Sess., p. 3, 1 Leg. Hist. 999.

There is nothing to the contrary in the 1957 report to the Joint Committee on Atomic Energy, mentioned by the majority in the court of appeals (R. 964). The report appraised the most extreme consequences of hypothetical incidents in a hypothetical nuclear power plant, prepared as a background for consideration of a bill to provide Government indemnity to licensees and contractors, which became Section 170 of the Act, *infra*, pp. 117–123. The report analyzed generally the possibility of such hypothetical incidents and discussed the principles underlying the Commission's reactor safety program and the past record. It concluded that the possibility of injury to members of the public, or of a major incident, *i.e.*, one in which substantial quantities of fis-

[20] High cost power areas, like New England, are entitled to preferred consideration in the licensing of commercial power reactors. In such licensing, the Commission shall also give prior notice to municipalities, public, cooperative and privately-owned utilities "within transmission distance". See 182 (c), (d), 42 U.S.C. 2232 (c), (d).

sion products were released, was "exceedingly small" (R. 349, 354, 879–886).[29] These findings proceeded upon the assumption that a site about 30 miles from a major city is a "typical location" for a power reactor. The assumption was based upon the commercial and government projects then proposed (R. 888, 914–917). The description is especially significant, for Congress expressly relied upon the report in enacting the indemnity legislation; and the legislation itself was designed to encourage further private participation in atomic power at such "typical" sites by providing governmental indemnity against liability. S. Rep. 296, 85th Cong., 1st Sess., pp. 1–3, 5–6, 31–34; H.

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[29] In placing reliance upon statements in this study, the court below may have been under a misapprehension of what hazards are presented by the operation of a power reactor. See *supra*, pp. 15–19.

Moreover, as the 1957 report states, it was "not in any sense a prediction of any future condition" and safety of a particular reactor or type "depends on the combination of many complex and inter-related factors" (R. 351, 880). In several obvious respects, the extreme hypothetical accident posited by the 1957 report cannot be applied to PRDC. The hypothetical plant had a capacity of 500,000 thermal kilowatts and a fuel reloading cycle of 180 days (R. 887), and therefore would contain much more fission products than PRDC with its 300,000 thermal kilowatts and more frequent reloading (R. 740–741). The extreme hypothetical accident also assumed a release to the atmosphere of 50% of all fission products in the reactor under adverse meteorological conditions (R. 893, 898–900), while the Commission concluded that the steel containment shell around the PRDC reactor would be shown to be able to contain the consequences of any credible accident, and that no significant quantities of fission products would be released into the atmosphere (R. 677, 706, 710).

Rep. 435, 85th Cong., 1st Sess., pp. 1–3, 5–6, 31–34. The legislative history of the 1957 amendment, as well as the subsequent discussion before Congress of the indemnity program, therefore, demonstrates a clear Congressional understanding that sites near populated areas would be utilized and that population density is but one of the "combination of features" [30]

[30] The Director of the Commission's Division of Licensing and Regulation, discussing site criteria at a 1958 hearing, pointed out that "there is always a combination of features that have to be looked at. * * * what would be a reasonably safe distance for one type of reactor with one kind of containment might not be suitable for a different reactor in a different location with or without a different kind of containment. Representative HOLIFIELD. That is right." Hearings on Operation of AEC Indemnity Act before the Joint Committee on Atomic Energy, 85th Cong., 2d Sess., p. 53.

Representative Holifield had dissented a year earlier from the indemnity legislation on the ground that power reactors could be developed at "isolated locations" and there were "no compelling reasons" for the government to assume indemnification liability. H. Rep. 435, 85th Cong., 1st Sess., pp. 38, 39–40. The above quotation, and the 1957 context, shows that even this dissenting observation was not intended to imply any limitation upon the Commission's power to regulate reactor sites under the terms of the Atomic Energy Act of 1954. For other discussions of reactor sites in connection with the indemnity legislation, see Hearings before the Joint Committee on Atomic Energy on Governmental Indemnity, 84th Cong., 2d Sess., pp. 60–65, 211–215; on Governmental Indemnity and Reactor Safety, 85th Cong., 1st Sess., pp. 10–12, 26–27, 54–55, 116–121; on Operation of AEC Indemnity Act, 85th Cong., 2d Sess., 51–53, 57–58; on Indemnity and Reactor Safety, 86th Cong., 2d Sess., pp. 192–209, 225–226, 241–242. See also Section 140.12 of the Commission's regulations (10 CFR, as amended, 25 F.R. 2944), utilizing population densities to calculate the insurance required of licensees.

to be considered by the Commission in exercising its regulatory authority.

As shown above (pp. 73, 79–80), in the present case the Commission took this factor into account and gave it adequate weight in making the undisputed finding that there was reasonable assurance that the reactor could be constructed and operated "at the location without undue risk to the health and safety of the public" (R. 708).

CONCLUSION

The judgment of the court of appeals should be reversed.

Respectfully submitted.

ARCHIBALD COX,
Solicitor General.
WILLIAM H. ORRICK, JR.,
Assistant Attorney General.
DANIEL M. FRIEDMAN,
Assistant to the Solicitor General.
MORTON HOLLANDER,
Attorney.

NEIL D. NAIDEN,
General Counsel,
COURTS OULAHAN,
Deputy General Counsel,
LIONEL KESTENBAUM,
Attorney,
Atomic Energy Commission.

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APPENDIX A

STATUTE AND REGULATIONS INVOLVED

1. The Atomic Energy Act of 1954, 68 Stat. 919, as amended, 42 U.S.C. 2011 *et seq.*, provides in pertinent part:

> SEC. 1. DECLARATION.—Atomic energy is capable of application for peaceful as well as military purposes. It is therefore declared to be the policy of the United States that—
>
> a. the development, use, and control of atomic energy shall be directed so as to make the maximum contribution to the general welfare, subject at all times to the paramount objective of making the maximum contribution to the common defense and security; and
>
> b. the development, use, and control of atomic energy shall be directed so as to promote world peace, improve the general welfare, increase the standard of living, and strengthen free competition in private enterprise.
>
> * * * * *
>
> SEC. 2. FINDINGS.—The Congress of the United States hereby makes the following findings concerning the development, use, and control of atomic energy:
>
> a. The development, utilization, and control of atomic energy for military and for all other purposes are vital to the common defense and security.
>
> b. In permitting the property of the United States to be used by others, such use must be regulated in the national interest and in order to provide for the common defense and security

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and to protect the health and safety of the public.

c. The processing and utilization of source, byproduct, and special nuclear material affect interstate and foreign commerce and must be regulated in the national interest.

d. The processing and utilization of source, byproduct, and special nuclear material must be regulated in the national interest, and in order to provide for the common defense and security and to protect the health and safety of the public.

e. Source and special nuclear material, production facilities, and utilization facilities are affected, with the public interest, and regulation by the United States of the production and utilization of atomic energy and of the facilities used in connection therewith is necessary in the national interest to assure the common defense and security and to protect the health and safety of the public.

f. The necessity for protection against possible interstate damage occurring from the operation of facilities for the production or utilization of source or special nuclear material places the operation of those facilities in interstate commerce for the purposes of this Act.

g. Funds of the United States may be provided for the development and use of atomic energy under conditions which will provide for the common defense and security and promote the general welfare.

h. It is essential to the common defense and security that title to all special nuclear material be in the United States while such special nuclear material is within the United States.

i. In order to protect the public and to encourage the development of the atomic energy industry, in the interest of the general welfare and of the common defense and security, the United States may make funds available for a

portion of the damages suffered by the public from nuclear incidents, and may limit the liability of those persons liable for such losses.

SEC. 3. PURPOSE.—It is the purpose of this Act to effectuate the policies set forth above by providing for—

a. a program of conducting, assisting, and fostering research and development in order to encourage maximum scientific and industrial progress;

b. a program for the dissemination of unclassified scientific and technical information and for the control, dissemination, and declassification of Restricted Data, subject to appropriate safeguards, so as to encourage scientific and industrial progress;

c. a program for Government control of the possession, use, and production of atomic energy and special nuclear material so directed as to make the maximum contribution to the common defense and security and the national welfare;

d. a program to encourage widespread participation in the development and utilization of atomic energy for peaceful purposes to the maximum extent consistent with the common defense and security and with the health and safety of the public;

e. a program of international cooperation to promote the common defense and security and to make available to cooperating nations the benefits of peaceful applications of atomic energy as widely as expanding technology and considerations of the common defense and security will permit; and

f. a program of administration which will be consistent with the foregoing policies and programs, with international arrangements, and with agreements for cooperation, which will enable the Congress to be currently informed so as to take further legislative action as may be appropriate.

* * * * *

SEC. 29. ADVISORY COMMITTEE ON REACTOR SAFEGUARDS.—There is hereby established an Advisory Committee on Reactor Safeguards consisting of a maximum of fifteen members appointed by the Commission for terms of four years each. The Committee shall review safety studies and facility license applications referred to it and shall make reports thereon, shall advise the Commission with regard to the hazards of proposed or existing reactor facilities and the adequacy of proposed reactor safety standards, and shall perform such other duties as the Commission may request. One member shall be designated by the Committee as its Chairman. The members of the Committee shall receive a per diem compensation for each day spent in meetings or conferences, or other work of the Committee, and all members shall receive their necessary traveling or other expenses while engaged in the work of the Committee. The provisions of section 163 shall be applicable to the Committee.

* * * * *

SEC. 31. RESEARCH ASSISTANCE.—

a. The Commission is directed to exercise its powers in such manner as to insure the continued conduct of research and development and training activities in the fields specified below, by private or public institutions or persons, and to assist in the acquisition of an ever-expanding fund of theoretical and practical knowledge in such fields. To this end the Commission is authorized and directed to make arrangements (including contracts, agreements, and loans) for the conduct of research and development activities relating to—

(1) nuclear processes;

(2) the theory and production of atomic energy, including processes, materials, and devices related to such production;

(3) utilization of special nuclear material and radioactive material for medical, biological, agricultural, health, or military purposes;

(4) utilization of special nuclear material, atomic energy, and radioactive material and processes entailed in the utilization or production of atomic energy or such material for all other purposes, including industrial uses, the generation of usable energy, and the demonstration of the practical value of utilization or production facilities for industrial or commercial purposes; and

(5) the protection of health and the promotion of safety during research and production activities.

b. The Commission is further authorized to make grants and contributions to the cost of construction and operation of reactors and other facilities and other equipment to colleges, universities, hospitals, and eleemosynary or charitable institutions for the conduct of educational and training activities relating to the fields in subsection a.

c. The Commission may (1) make arrangements pursuant to this section, without regard to the provisions of section 3709 of the Revised Statutes, as amended, upon certification by the Commission that such action is necessary in the interest of the common defense and security, or upon a showing by the Commission that advertising is not reasonably practicable; (2) make partial and advance payments under such arrangements; and (3) make available for use in connection therewith such of its equipment and facilities as it may deem desirable.

d. The arrangements made pursuant to this section shall contain such provisions (1) to protect health, (2) to minimize danger to life or property, and (3) to require the reporting and to permit the inspection of work per-

formed thereunder, as the Commission may determine. No such arrangement shall contain any provisions or conditions which prevent the dissemination of scientific or technical information, except to the extent such dissemination is prohibited by law.

SEC. 32. RESEARCH BY THE COMMISSION.—The Commission is authorized and directed to conduct, through its own facilities, activities and studies of the types specified in section 31.

SEC. 33. RESEARCH FOR OTHERS.—Where the Commission finds private facilities or laboratories are inadequate to the purpose, it is authorized to conduct for other persons, through its own facilities, such of those activities and studies of the types specified in section 31 as it deems appropriate to the development of atomic energy. The Commission is authorized to determine and make such charges as in its discretion may be desirable for the conduct of such activities and studies.

* * * * *

SEC. 41. OWNERSHIP AND OPERATION OF PRODUCTION FACILITIES.—

a. OWNERSHIP OF PRODUCTION FACILITIES.—The Commission, as agent of and on behalf of the United States, shall be the exclusive owner of all production facilities other than facilities which (1) are useful in the conduct of research and development activities in the fields specified in section 31, and do not, in the opinion of the Commission, have a potential production rate adequate to enable the user of such facilities to produce within a reasonable period of time a sufficient quantity of special nuclear material to produce an atomic weapon; or (2) are licensed by the Commission pursuant to section 103 or 104.

b. OPERATION OF THE COMMISSION'S PRODUCTION FACILITIES.—The Commission is authorized and directed to produce or to provide for the production of special nuclear material in its

own production facilities. To the extent deemed necessary, the Commission is authorized to make, or to continue in effect, contracts with persons obligating them to produce special nuclear material in facilities owned by the Commission. The Commission is also authorized to enter into research and development contracts authorizing the contractor to produce special nuclear material in facilities owned by the Commission to the extent that the production of such special nuclear material may be incident to the conduct of research and development activities under such contracts. Any contract entered into under this section shall contain provisions (1) prohibiting the contractor from subcontracting any part of the work he is obligated to perform under the contract, except as authorized by the Commission; and (2) obligating the contractor (A) to make such reports pertaining to activities under the contract to the Commission as the Commission may require, (B) to submit to inspection by employees of the Commission of all such activities, and (C) to comply with all safety and security regulations which may be prescribed by the Commission. Any contract made under the provisions of this paragraph may be made without regard to the provisions of section 3709 of the Revised Statutes, as amended, upon certification of the Commission that such action is necessary in the interest of the common defense and security, or upon a showing by the Commission that advertising is not reasonably practicable. Partial and advance payments may be made under such contracts. The President shall determine in writing at least once each year the quantities of special nuclear material to be produced under this section and shall specify in such determination the quantities of special nuclear material to be available for distribution by the Commission pursuant to section 53 or 54.

c. OPERATION OF OTHER PRODUCTION FACILITIES.—Special nuclear material may be produced in the facilities which under this section are not required to be owned by the Commission.

SEC. 42. IRRADIATION OF MATERIALS.—The Commission and persons lawfully producing or utilizing special nuclear material are authorized to expose materials of any kind to the radiation incident to the processes of producing or utilizing special nuclear material.

SEC. 43. ACQUISITION OF PRODUCTION FACILITIES.—The Commission is authorized to purchase any interest in facilities for the production of special nuclear materials, or in real property on which such facilities are located, without regard to the provisions of section 3709 of the Revised Statutes, as amended, upon certification by the Commission that such action is necessary in the interest of the common defense and security, or upon a showing by the Commission that advertising is not reasonably practicable. Partial and advance payments may be made under contracts for such purposes. The Commission is further authorized to requisition, condemn, or otherwise acquire any interest in such production facilities, or to condemn or otherwise acquire such real property, and just compensation shall be made therefor.

SEC. 44. DISPOSITION OF ENERGY.—If energy is produced at production facilities of the Commission or is produced in experimental utilization facilities of the Commission, such energy may be used by the Commission, or transferred to other Government agencies, or sold to publicly, cooperatively, or privately owned utilities or users at reasonable and nondiscriminatory prices. If the energy produced is electric energy, the price shall be subject to regulation by the appropriate agency having jurisdiction.

In contracting for the disposal of such energy, the Commission shall give preference and priority to public bodies and cooperatives or to privately owned utilities providing electric utility services to high cost areas not being served by public bodies or cooperatives. Nothing in this Act shall be construed to authorize the Commission to engage in the sale or distribution of energy for commercial use except such energy as may be produced by the Commission incident to the operation of research and development facilities of the Commission, or of production facilities of the Commission.

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SEC. 51. SPECIAL NUCLEAR MATERIAL.—The Commission may determine from time to time that other material is special nuclear material in addition to that specified in the definition as special nuclear material. Before making any such determination, the Commission must find that such material is capable of releasing substantial quantities of atomic energy and must find that the determination that such material is special nuclear material is in the interest of the common defense and security, and the President must have expressly assented in writing to the determination. The Commission's determination, together with the assent of the President, shall be submitted to the Joint Committee and a period of thirty days shall elapse while Congress is in session (in computing such thirty days, there shall be excluded the day on which either House is not in session because of an adjournment for more than three days) before the determination of the Commission may become effective: *Provided, however,* That the Joint Committee, after having received such determination, may by resolution in writing, waive the conditions of all or any portion of such thirty-day period.

SEC. 52. GOVERNMENT OWNERSHIP OF ALL SPECIAL NUCLEAR MATERIAL.—All rights, title,

and interest in or to any special nuclear material within or under the jurisdiction of the United States, now or hereafter produced, shall be the property of the United States and shall be administered and controlled by the Commission as agent of and on behalf of the United States by virtue of this Act. Any person owning any interest in any special nuclear material at the time when such material is hereafter determined to be a special nuclear material shall be paid just compensation therefor. Any person who lawfully produces any special nuclear material, except pursuant to a contract with the Commission under the provisions of section 31 or 41, shall be paid a fair price, determined pursuant to section 56, for producing such material.

SEC. 53. DOMESTIC DISTRIBUTION OF SPECIAL NUCLEAR MATERIAL.—

a. The Commission is authorized to issue licenses for the possession of, to make available for the period of the license, and to distribute special nuclear material within the United States to qualified applicants requesting such material—

(1) for the conduct of research and development activities of the types specified in section 31;

(2) for use in the conduct of research and development activities or in medical therapy under a license issued pursuant to section 104;

(3) for use under a license issued pursuant to section 103;

(4) for such other uses as the Commission determines to be appropriate to carry out the purposes of this Act.

b. The Commission shall establish, by rule, minimum criteria for the issuance of specific or general licenses for the distribution of special nuclear material depending upon the degree of importance to the common defense and security or to the health and safety of the public of—

(1) the physical characteristics of the special nuclear material to be distributed;

(2) the quantities of special nuclear material to be distributed; and

(3) the intended use of the special nuclear material to be distributed.

c. The Commission may make a reasonable charge, determined pursuant to this section, for the use of special nuclear material licensed and distributed under subsection 53 a. (1), (2) or (4) and shall make a reasonable charge determined pursuant to this section for the use of special nuclear material licensed and distributed under subsection 53 a. (3). The Commission shall establish criteria in writing for the determination of whether a charge will be made for the use of special nuclear material licensed and distributed under subsection 53 a. (1), (2) or (4), considering, among other things, whether the licensee is a nonprofit or eleemosynary institution and the purposes for which the special nuclear material will be used.

d. In determining the reasonable charge to be made by the Commission for the use of special nuclear material distributed to licensees of utilization or production facilities licensed pursuant to section 103 or 104, in addition to consideration of the cost thereof, the Commission shall take into consideration—

(1) the use to be made of the special nuclear material;

(2) the extent to which the use of the special nuclear material will advance the development of the peaceful uses of atomic energy;

(3) the energy value of the special nuclear material in the particular use for which the license is issued;

(4) whether the special nuclear material is to be used in facilities licensed pursuant to section 103 or 104. In this respect, the Commission shall, insofar as practicable, make uniform, nondiscriminatory charges for the use of spe-

cial nuclear material distributed to facilities licensed pursuant to section 103; and

(5) with respect to special nuclear material consumed in a facility licensed pursuant to section 103, the Commission shall make a further charge based on the cost to the Commission, as estimated by the Commission, or the average fair price paid for the production of such special nuclear material as determined by section 56, whichever is lower.

e. Each license issued pursuant to this section shall contain and be subject to the following conditions—

(1) title to all special nuclear material shall at all times be in the United States;

(2) no right to the special nuclear material shall be conferred by the license except as defined by the license;

(3) neither the license nor any right under the license shall be assigned or otherwise transferred in violation of the provisions of this Act;

(4) all special nuclear material shall be subject to the right of recapture or control reserved by section 108 and to all other provisions of this Act;

(5) no special nuclear material may be used in any utilization or production facility except in accordance with the provisions of this Act;

(6) special nuclear material shall be distributed only on terms, as may be established by rule of the Commission, such that no user will be permitted to construct an atomic weapon;

(7) special nuclear material shall be distributed only pursuant to such safety standards as may be established by rule of the Commission to protect health and to minimize danger to life or property; and

(8) except to the extent that the indemnification and limitation of liability provisions of

section 170 apply, the licensee will hold the United States and the Commission harmless from any damages resulting from the use or possession of special nuclear material by the licensee.

f. The Commission is directed to distribute within the United States sufficient special nuclear material to permit the conduct of widespread independent research and development activities to the maximum extent practicable and within the limitations set by the President pursuant to section 41. In the event that applications for special nuclear material exceed the amount available for distribution, preference shall be given to those activities which are most likely, in the opinion of the Commission, to contribute to basic research, to the development of peacetime uses of atomic energy, or to the economic and military strength of the Nation.

* * * * *

SEC. 57. PROHIBITION.—

a. It shall be unlawful for any person to—

(1) possess or transfer any special nuclear material which is the property of the United States except as authorized by the Commission pursuant to subsection 53 a.;

(2) transfer or receive any special nuclear material in interstate commerce except as authorized by the Commission pursuant to subsection 53a., or export from or import into the United States any special nuclear material; and

(3) directly or indirectly engage in the production of any special nuclear material outside of the United States except (A) under an agreement for cooperation made pursuant to section 123, or (B) upon authorization by the Commission after a determination that such activity will not be inimical to the interest of the United States.

b. The Commission shall not distribute any special nuclear material—

(1) to any person for a use which is not under the jurisdiction of the United States except pursuant to the provisions of section 54; or

(2) to any person within the United States, if the Commission finds that the distribution of such special nuclear material to such person would be inimical to the common defense and security.

SEC. 58. REVIEW.—Before the Commission establishes any fair price or guaranteed fair price period in accordance with the provisions of section 56, or establishes any criteria for the waiver of any charge for the use of special nuclear material licensed or distributed under section 53 the proposed fair price, guaranteed fair price period, or criteria for the waiver of such charge shall be submitted to the Joint Committee, and a period of forty-five days shall elapse while Congress is in session (in computing such forty-five days there shall be excluded the days in which either House is not in session because of adjournment for more than three days): *Provided, however,* That the Joint Committee, after having received the proposed fair price, guaranteed fair price period, or criteria for the waiver of such charge, may by resolution waive the conditions of or all or any portion of such forty-five day period.

* * * * *

SEC. 61. SOURCE MATERIAL.—The Commission may determine from time to time that other material is source material in addition to those specified in the definition of source material. Before making such determination, the Commission must find that such material is essential to the production of special nuclear material and must find that the determination that such

material is source material is in the interest of the common defense and security, and the President must have expressly assented in writing to the determination. The Commission's determination, together with the assent of the President, shall be submitted to the Joint Committee and a period of thirty days shall elapse while Congress is in session (in computing such thirty days, there shall be excluded the days on which either House is not in session because of an adjournment of more than three days) before the determination of the Commission may become effective: *Provided, however,* That the Joint Committee, after having received such determination, may by resolution in writing waive the conditions of or all or any portion of such thirty-day period.

SEC. 62. LICENSE FOR TRANSFERS REQUIRED.—Unless authorized by a general or specific license issued by the Commission, which the Commission is hereby authorized to issue, no person may transfer or receive in interstate commerce, transfer, deliver, receive possession of or title to, or import into or export from the United States any source material after removal from its place of deposit in nature, except that licenses shall not be required for quantities of source material which, in the opinion of the Commission, are unimportant.

SEC. 63. DOMESTIC DISTRIBUTION OF SOURCE MATERIAL.—

a. The Commission is authorized to issue licenses for and to distribute source material within the United States to qualified applicants requesting such material—

(1) for the conduct of research and development activities of the types specified in section 31;

(2) for use in the conduct of research and development activities or in medical therapy under a license issued pursuant to section 104;

(3) for use under a license issued pursuant to section 103; or

(4) for any other use approved by the Commission as an aid to science or industry.

b. The Commission shall establish, by rule, minimum criteria for the issuance of specific or general licenses for the distribution of source material depending upon the degree of importance to the common defense and security or to the health and safety of the public of—

(1) the physical characteristics of the source material to be distributed;

(2) the quantities of source material to be distributed; and

(3) the intended use of the source material to be distributed.

c. The Commission may make a reasonable charge determined pursuant to subsection 161 m. for the source material licensed and distributed under subsection 63 a. (1), subsection 63 a. (2), or subsection 63 a. (4), and shall make a reasonable charge determined pursuant to subsection 161 m., for the source material licensed and distributed under subsection 63 a. (3). The Commission shall establish criteria in writing for the determination of whether a charge will be made for the source material licensed and distributed under subsection 63 a. (1), subsection 63 a. (2), or subsection 63 a. (4), considering, among other things, whether the licensee is a nonprofit or eleemosynary institution and the purposes for which the source material will be used.

SEC. 64. FOREIGN DISTRIBUTION OF SOURCE MATERIAL.—The Commission is authorized to cooperate with any nation by distributing source material and to distribute source material pursuant to the terms of an agreement for cooperation to which such nation is a party and which is made in accordance with section 123. The Commission is also authorized to distribute source material outside of the United States

upon a determination by the Commission that such activity will not be inimical to the interests of the United States.

SEC. 65. REPORTING.—The Commission is authorized to issue such rules, regulations or orders requiring reports of ownership, possession, extraction, refining, shipment, or other handling of source material as it may deem necessary, except that such reports shall not be required with respect to (a) any source material prior to removal from its place of deposit in nature, or (b) quantities of source material which in the opinion of the Commission are unimportant or the reporting of which will discourage independent prospecting for new deposits.

SEC. 66. ACQUISITION.—The Commission is authorized and directed, to the extent it deems necessary to effectuate the provisions of this Act—

a. to purchase, take, requisition, condemn, or otherwise acquire supplies or source material;

b. to purchase, condemn, or otherwise acquire any interest in real property containing deposits of source material; and

c. to purchase, condemn, or otherwise acquire rights to enter upon any real property deemed by the Commission to have possibilities of containing deposits of source material in order to conduct prospecting and exploratory operations for such deposits.

Any purchase made under this section may be made without regard to the provisions of section 3709 of the Revised Statutes, as amended, upon certification by the Commission that such action is necessary in the interest of the common defense and security, or upon a showing by the Commission that advertising is not reasonably practicable. Partial and advanced payments may be made under contracts for such purposes. The Commission may establish guaranteed prices for all source material delivered to it within a specified time. Just com-

pensation shall be made for any right, property, or interest in property taken, requisitioned, condemned, or otherwise acquired under this section.

* * * * *

SEC. 81. DOMESTIC DISTRIBUTION.—No person may transfer or receive in interstate commerce, manufacture, produce, transfer, acquire, own, possess, import, or export any byproduct material, except to the extent authorized by this section or by section 82. The Commission is authorized to issue general or specific licenses to applicants seeking to use byproduct material for research or development purposes, for medical therapy, industrial uses, agricultural uses, or such other useful applications as may be developed. The Commission may distribute, sell, loan, or lease such byproduct material as it owns to licensees with or without charge: *Provided, however,* That for byproduct material to be distributed by the Commission for a charge, the Commission shall establish prices on such equitable basis as, in the opinion of the Commission, (a) will provide reasonable compensation to the Government for such material, (b) will not discourage the use of such material or the development of sources of supply of such material independent of the Commission, and (c) will encourage research and development. In distributing such material, the Commission shall give preference to applicants proposing to use such material either in the conduct of research and development or in medical therapy. Licensees of the Commission may distribute byproduct material only to applicants therefor who are licensed by the Commission to receive such byproduct material. The Commission shall not permit the distribution of any byproduct material to any licensee, and shall recall or order the recall of any distributed material from any licensee, who is not equipped to observe or who fails

to observe such safety standards to protect health as may be established by the Commission or who uses such material in violation of law or regulation of the Commission or in a manner other than as disclosed in the application therefor or approved by the Commission. The Commission is authorized to establish classes of byproduct material and to exempt certain classes or quantities of material or kinds of uses or users from the requirements for a license set forth in this section when it makes a finding that the exemption of such classes or quantities of such material or such kinds of uses or users will not constitute an unreasonable risk to the common defense and security and to the health and safety of the public.

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SEC. 101. LICENSE REQUIRED.—It shall be unlawful, except as provided in section 91, for any person within the United States to transfer or receive in interstate commerce, manufacture, produce, transfer, acquire, possess, use, import, or export any utilization or production facility except under and in accordance with a license issued by the Commission pursuant to section 103 or 104.

SEC. 102. FINDING OF PRACTICAL VALUE.—Whenever the Commission has made a finding in writing that any type of utilization or production facility has been sufficiently developed to be of practical value for industrial or commercial purposes, the Commission may thereafter issue licenses for such type of facility pursuant to section 103.

SEC. 103. COMMERCIAL LICENSES.—

a. Subsequent to a finding by the Commission as required in section 102, the Commission may issue licenses to transfer or receive in interstate commerce, manufacture, produce, transfer, acquire, possess, use, import, or export under the terms of an agreement for coopera-

tion arranged pursuant to section 123, such type of utilization or production facility. Such licenses shall be issued in accordance with the provisions of chapter 16 and subject to such conditions as the Commission may by rule or regulation establish to effectuate the purposes and provisions of this Act.

b. The Commission shall issue such licenses on a nonexclusive basis to persons applying therefor (1) whose proposed activities will serve a useful purpose proportionate to the quantities of special nuclear material or source material to be utilized; (2) who are equipped to observe and who agree to observe such safety standards to protect health and to minimize danger to life or property as the Commission may by rule establish; and (3) who agree to make available to the Commission such technical information and data concerning activities under such licenses as the Commission may determine necessary to promote the common defense and security and to protect the health and safety of the public. All such information may be used by the Commission only for the purposes of the common defense and security and to protect the health and safety of the public.

c. Each such license shall be issued for a specified period, as determined by the Commission, depending on the type of activity to be licensed, but not exceeding forty years, and may be renewed upon the expiration of such period.

d. No license under this section may be given to any person for activities which are not under or within the jurisdiction of the United States, except for the export of production or utilization facilities under terms of an agreement for cooperation arranged pursuant to section 123, or except under the provisions of section 109. No license may be issued to an alien or any corporation or other entity if the Commission

knows or has reason to believe it is owned, controlled, or dominated by an alien, a foreign corporation, or a foreign government. In any event, no license may be issued to any person within the United States if, in the opinion of the Commission, the issuance of a license to such person would be inimical to the common defense and security or to the health and safety of the public.

SEC. 104. MEDICAL THERAPY AND RESEARCH AND DEVELOPMENT.—

a. The Commission is authorized to issue licenses to persons applying therefor for utilization facilities for use in medical therapy. In issuing such licenses the Commission is directed to permit the widest amount of effective medical therapy possible with the amount of special nuclear material available for such purposes and to impose the minimum amount of regulation consistent with its obligations under this Act to promote the common defense and security and to protect the health and safety of the public.

b. The Commission is authorized to issue licenses to persons applying therefor for utilization and production facilities involved in the conduct of research and development activities leading to the demonstration of the practical value of such facilities for industrial or commercial purposes. In issuing licenses under this subsection, the Commission shall impose the minimum amount of such regulations and terms of license as will permit the Commission to fulfill its obligations under this Act to promote the common defense and security and to protect the health and safety of the public and will be compatible with the regulations and terms of license which would apply in the event that a commercial license were later to be issued pursuant to section 103 for that type of facility. In issuing such licenses, priority shall be given to those activities which will, in the opinion of

the Commisson, lead to major advances in the application of atomic energy for industrial or commercial purposes.

c. The Commission is authorized to issue licenses to persons applying therefor for utilization and production facilities useful in the conduct of research and development activities of the types specified in section 31 and which are not facilities of the type specified in subsection 104 b. The Commission is directed to impose only such minimum amount of regulation of the licensee as the Commission finds will permit the Commission to fulfill its obligations under this Act to promote the common defense and security and to protect the health and safety of the public and will permit the conduct of widespread and diverse research and development.

d. No license under this section may be given to any person for activities which are not under or within the jurisdiction of the United States, except for the export of production or utilization facilities under terms of an agreement for cooperation arranged pursuant to section 123 or except under the provisions of section 109. No license may be issued to any corporation or other entity if the Commission knows or has reason to believe it is owned, controlled, or dominated by an alien, a foreign corporation, or a foreign government. In any event, no license may be issued to any person within the United States if, in the opinion of the Commission, the issuance of a license to such person would be inimical to the common defense and security or to the health and safety of the public.

SEC. 105. ANTITRUST PROVISIONS.—

a. Nothing contained in this Act, including the provisions which vest title to all special nuclear material in the United States, shall relieve any person from the operation of the following Acts, as amended: "An Act to protect trade and commerce against unlawful restraints

and monopolies" approved July second, eighteen hundred and ninety; sections seventy-three to seventy-seven, inclusive, of an Act entitled "An Act to reduce taxation, to provide revenue for the Government, and for other purposes" approved August twenty-seven, eighteen hundred and ninety-four; "An Act to supplement existing laws against unlawful restraints and monopolies, and for other purposes" approved October fifteen, nineteen hundred and fourteen; and "An Act to create a Federal Trade Commission, to define its powers and duties, and for other purposes" approved September twenty-six, nineteen hundred and fourteen. In the event a licensee is found by a court of competent jurisdiction, either in an original action in that court or in a proceeding to enforce or review the findings or orders of any Government agency having jurisdiction under the laws cited above, to have violated any of the provisions of such laws in the conduct of the licensed activity, the Commission may suspend, revoke, or take such other action as it may deem necessary with respect to any license issued by the Commission under the provisions of this Act.

b. The Commission shall report promptly to the Attorney General any information it may have with respect to any utilization of special nuclear material or atomic energy which appears to violate or to tend toward the violation of any of the foregoing Acts, or to restrict free competition in private enterprise.

c. Whenever the Commission proposes to issue any license to any person under section 103, it shall notify the Attorney General of the proposed license and the proposed terms and conditions thereof, except such classes or types of licenses, as the Commision, with the approval of the Attorney General, may determine would not significantly affect the licensee's activities

under the antitrust laws as specified in subsection 105 a. Within a reasonable time, in no event to exceed 90 days after receiving such notification, the Attorney General shall advise the Commission whether, insofar as he can determine, the proposed license would tend to create or maintain a situation inconsistent with the antitrust laws, and such advice shall be published in the Federal Register. Upon the request of the Attorney General, the Commission shall furnish or cause to be furnished such information as the Attorney General determines to be appropriate or necessary to enable him to give the advice called for by this section.

SEC. 106. CLASSES OF FACILITIES.—The Commission may—

a. group the facilities licensed either under section 103 or under section 104 into classes which may include either production or utilization facilities or both, upon the basis of the similarity of operating and technical characteristics of the facilities;

b. define the various activities to be carried on at each such class of facility; and

c. designate the amounts of special nuclear material available for use by each such facility.

SEC. 107. OPERATORS' LICENSES.—The Commission shall—

a. prescribe uniform conditions for licensing individuals as operators of any of the various classes of production and utilization facilities licensed in this Act;

b. determine the qualifications of such individuals;

c. issue licenses to such individuals in such form as the Commission may prescribe; and

d. suspend such licenses for violations of any provision of this Act or any rule or regulation issued thereunder whenever the Commission deems such action desirable.

SEC. 108. WAR OR NATIONAL EMERGENCY.—Whenever the Congress declares that a state of

war or national emergency exists, the Commission is authorized to suspend any licenses granted under this Act if in its judgment such action is necessary to the common defense and security. The Commission is authorized during such period, if the Commission finds it necessary to the common defense and security, to order the recapture of any special nuclear material or to order the operation of any facility licensed under section 103 or 104, and is authorized to order the entry into any plant or facility in order to recapture such material, or to operate such facility. Just compensation shall be paid for any damages caused by the recapture of any special nuclear material or by the operation of any such facility.

SEC. 109. COMPONENT PARTS OF FACILITIES.—With respect to those utilization and production facilities which are so determined by the Commission pursuant to subsection 11 p. (2) or 11 v. (2) the Commission may (a) issue general licenses for activities required to be licensed under section 101, if the Commission determines in writing that such general licensing will not constitute an unreasonable risk to the common defense and security, and (b) issue licenses for the export of such facilities, if the Commission determines in writing that each export will not constitute an unreasonable risk to the common defense and security.

SEC. 110. EXCLUSIONS.—Nothing in this chapter shall be deemed—

a. to require a license for (1) the processing, fabricating, or refining of special nuclear material, or the separation of special nuclear material, or the separation of special nuclear material from other substances, under contract with and for the account of the Commission; or (2) the construction or operation of facilities under contract with and for the account of the Commission; or

b. to require a license for the manufacture, production, or acquisition by the Department of Defense of any utilization facility authorized pursuant to section 91, or for the use of such facility by the Department of Defense or a contractor thereof.

* * * * *

SEC. 161. GENERAL PROVISIONS.—In the performance of its functions the Commission is authorized to—

b. establish by rule, regulation, or order, such standards and instructions to govern the possession and use of special nuclear material, source material, and byproduct material as the Commission may deem necessary or desirable to promote the common defense and security or to protect health or to minimize danger to life or property;

* * * * *

i. prescribe such regulations or orders as it may deem necessary (1) to protect Restricted Data received by any person in connection with any activity authorized pursuant to this Act, (2) to guard against the loss or diversion of any special nuclear material acquired by any person pursuant to section 53 or produced by any person in connection with any activity authorized pursuant to this Act, and to prevent any use or disposition thereof which the Commisison may determine to be inimical to the common defense and security, and (3) to govern any activity authorized pursuant to this Act, including standards and restrictions governing the design, location, and operation of facilities used in the conduct of such activity, in order to protect health and to minimize danger to life or property;

* * * * *

p. make, promulgate, issue, rescind, and amend such rules and regulations as may be necessary to carry out the purposes of this Act.

* * * * * *

SEC. 170. INDEMNIFICATION AND LIMITATION OF LIABILITY.—

a. Each license issued under section 103 or 104 and each construction permit issued under section 185 shall, and each license issued under section 53, 63, or 81 may, have as a condition of the license a requirement that the licensee have and maintain financial protection of such type and in such amounts as the Commission shall require in accordance with subsection 170 b. to cover public liability claims. Whenever such financial protection is required, it shall be a further condition of the license that the licensee execute and maintain an indemnification agreement in accordance with subsection 170 c. The Commission may require, as a further condition of issuing a license, that an applicant waive any immunity from public liability conferred by Federal or State law.

b. The amount of financial protection required shall be the amount of liability insurance available from private sources, except that the Commission may establish a lesser amount on the basis of criteria set forth in writing, which it may revise from time to time, taking into consideration such factors as the following: (1) the cost and terms of private insurance, (2) the type, size, and location of the licensed activity and other factors pertaining to the hazard, and (3) the nature and purpose of the licensed activity: *Provided,* That for facilities designed for producing substantial amounts of electricity and having a rated capacity of 100,000 electrical kilowatts or more, the amount of financial protection required shall be the maximum amount available from private sources. Such financial protection may include private insurance, private contractual indemnities, self insurance, other proof of financial responsibility, or a combination of such measures.

c. The Commission shall, with respect to licenses issued between August 30, 1954, and August 1, 1967, for which it requires financial protection, agree to indemnify and hold harmless the licensee and other persons indemnified, as their interest may appear, from public liability arising from nuclear incidents which is in excess of the level of financial protection required of the licensee. The aggregate indemnity for all persons indemnified in connection with each nuclear incident shall not exceed $500,000,000 including the reasonable costs of investigating and settling claims and defending suits for damage. Such a contract of indemnification shall cover public liability arising out of or in connection with the licensed activity.

d. In addition to any other authority the Commission may have, the Commission is authorized until August 1, 1967, to enter into agreements of indemnification with its contractors for the construction or operation of production or utilization facilities or other activities under contracts for the benefit of the United States involving activities under the risk of public liability for a substantial nuclear incident. In such agreements of indemnification the Commission may require its contractor to provide and maintain financial protection of such a type and in such amounts as the Commission shall determine to be appropriate to cover public liability arising out of or in connection with the contractual activity, and shall indemnify the persons indemnified against such claims above the amount of the financial protection required, in the amount of $500,000,000 including the reasonable costs of investigating and settling claims and defending suits for damage in the aggregate for all persons indemnified in connection with such contract and for each nuclear incident. The provisions of this subsection may be applicable to lump sum

as well as cost type contracts and to contracts and projects financed in whole or in part by the Commission.

e. The aggregate liability for a single nuclear incident of persons indemnified, including the reasonable costs of investigating and settling claims and defending suits for damage, shall not exceed the sum of $500,000,000 together with the amount of financial protection required of the licensee or contractor. The Commission or any person indemnified may apply to the appropriate district court of the United States having venue in bankruptcy matters over the location of the nuclear incident, except that in the case of nuclear incidents caused by ships of the United States outside of the United States, the Commission or any person indemnified may apply to the appropriate district court of the United States having venue in bankruptcy matters over the location of the principal place of business of the shipping company owning or operating the ship, and upon a showing that the public liability from a single nuclear incident will probably exceed the limit of liability imposed by this section, shall be entitled to such orders as may be appropriate for enforcement of the provisions of this section, including an order limiting the liability of the persons indemnified, orders staying the payment of claims and the execution of court judgments, orders apportioning the payments to be made to claimants, orders permitting partial payments to be made before final determination of the total claims, and an order setting aside a part of the funds available for possible latent injuries not discovered until a later time.

f. The Commission is authorized to collect a fee from all persons with whom an indemnification agreement is executed under this section. This fee shall be $30 per year per thousand kilowatts of thermal energy capacity for facil-

ities licensed under section 103. For facilities licensed under section 104, and for construction permits under section 185, the Commission is authorized to reduce the fee set forth above. The Commission shall establish criteria in writing for determination of the fee for facilities licensed under section 104 taking into consideration such factors as (1) the type, size, and location of facility involved, and other factors pertaining to the hazard, and (2) the nature and purpose of the facility. For other licenses, the Commission shall collect such nominal fees as it deems appropriate. No fee under this subsection shall be less than $100 per year.

g. In administering the provisions of this section, the Commission shall use, to the maximum extent practicable, the facilities and services of private insurance organizations, and the Commission may contract to pay a reasonable compensation for such services. Any contract made under the provisions of this subsection may be made without regard to the provisions of section 3709 of the Revised Statutes, as amended, upon a showing by the Commission that advertising is not reasonably practicable and advance payments may be made.

h. The agreement of indemnification may contain such terms as the Commission deems appropriate to carry out the purposes of this section. Such agreement shall provide that, when the Commission makes a determination that the United States will probably be required to make indemnity payments under this section, the Commission shall collaborate with any person indemnified and may approve the payment of any claim under the agreement of indemnification, appear through the Attorney General on behalf of the person indemnified, take charge of such action, and settle or defend any such action. The Commission shall have

final authority on behalf of the United States to settle or approve the settlement of any such claim on a fair and reasonable basis with due regard for the purposes of this Act. Such settlement may include reasonable expenses in connection with the claim incurred by the person indemnified.

i. After any nuclear incident which will probably require payments by the United States under this section, the Commission shall make a survey of the causes and extent of damage which shall forthwith be reported to the Joint Committee, and, except as forbidden by the provisions of chapter 12 of this Act or any other law or Executive order, all final findings shall be made available to the public, to the parties involved and to the courts. The Commission shall report to the Joint Committee by April 1, 1958, and every year thereafter on the operations under this section.

j. In administering the provisions of this section, the Commission may make contracts in advance of appropriations and incur obligations without regard to section 3679 of the Revised Statutes, as amended.

k. With respect to any license issued pursuant to sections 53, 63, 81, 104 a., or 104 c. for the conduct of educational activities to a person found by the Commission to be a nonprofit educational institution, the Commission shall exempt such licensee from the financial protection requirement of subsection 170 a. With respect to licenses issued between August 30, 1954, and August 1, 1967, for which the Commission grants such exemption:

(1) the Commission shall agree to indemnify and hold harmless the licensee and other persons indemnified, as their interests may appear, from public liability in excess of $250,000 arising from nuclear incident. The aggregate indemnity for all persons indemnified in connec-

tion with each nuclear incident shall not exceed $500,000,000, including the reasonable cost of investigating and settling claims and defending suits for damage;

(2) such contracts of indemnification shall cover public liability arising out of or in connection with the licensed activity; and shall include damage to property of persons indemnified, except property which is located at the site of and used in connection with the activity where the nuclear incident occurs; and

(3) such contracts of indemnification, when entered into with a licensee having immunity from public liability because it is a State agency, shall provide also that the Commission shall make payments under the contract on account of activities of the licensee in the same manner and to the same extent as the Commission would be required to do if the licensee were not such a State agency.

Any licensee may waive an exemption to which it is entitled under this subsection.

1. The Commision is authorized until August 1, 1967, to enter into an agreement of indemnification with any person engaged in the design, development, construction, operation, repair, and maintenance or use of the nuclear-powered ship authorized by section 716 of the Merchant Marine Act, 1936, and designated the "nuclear ship Savannah". In any such agreement of indemnification the Commission may require such person to provide and maintain financial protection of such a type and in such amounts as the Commission shall determine to be appropriate to cover public liability arising from a nuclear incident in connection with such design, development, construction, operation, repair, maintenance or use and shall indemnify the person indemnified against such claims above the amount of the financial protection required, in the maximum amount provided by

subsection e. including the reasonable costs of investigating and settling claims and defending suits for damage.

* * * * *

SEC. 181. GENERAL.—The provisions of the Administrative Procedure Act (Public Law 404, Seventy-ninth Congress, approved June 11, 1946) shall apply to all agency action taken under this Act, and the terms "agency" and "agency action" shall have the meaning specified in the Administrative Procedure Act: *Provided, however,* That in the case of agency proceedings or actions which involve Restricted Data or defense information, the Commission shall provide by regulation for such parallel procedures as will effectively safeguard and prevent disclosure of Restricted Data or defense information to unauthorized persons with minimum impairment of the procedural rights which would be available if Restricted Data or defense information were not involved.

SEC. 182. LICENSE APPLICATIONS.—

a. Each application for a license hereunder shall be in writing and shall specifically state such information as the Commission, by rule or regulation, may determine to be necessary to decide such of the technical and financial qualifications of the applicant, the character of the applicant, the citizenship of the applicant, or any other qualifications of the applicant as the Commission may deem appropriate for the license. In connection with applications for licenses to operate production or utilization facilities, the applicant shall state such technical specifications, including information of the amount, kind, and source of special nuclear material required, the place of the use, the specific characteristics of the facility, and such other information as the Commission may, by rule or regulation, deem necessary in order to enable it to find that the utilization or production of special nuclear material will be in ac-

cord with the common defense and security and will provide adequate protection to the health and safety of the public. Such technical specifications shall be a part of any license issued. The Commission may at any time after the filing of the original application, and before the expiration of the license, require further written statements in order to enable the Commission to determine whether the application should be granted or denied or whether a license should be modified or revoked. All applications and statements shall be signed by the applicant or licensee. Applications for, and statements made in connection with, licenses under sections 103 and 104 shall be made under oath or affirmation. The Commission may require any other applications or statements to be made under oath or affirmation.

b. The Advisory Committee on Reactor Safeguards shall review each application under section 103 or 104 b for a license for a facility, any application under section 104 c. for a testing facility, and any application under section 104 a. or c. specifically referred to it by the Commission, and shall submit a report thereon, which shall be made part of the record of the application and available to the public, except to the extent that security classification prevents disclosure.

c. The Commission shall not issue any license for a utilization or production facility for the generation of commercial power under section 103, until it has given notice in writing to such regulatory agency as may have jurisdiction over the rates and services of the proposed activity, to municipalities, private utilities, public bodies, and cooperatives within transmission distance authorized to engage in the distribution of electric energy and until it has published notice of such application once each week for four consecutive weeks in the Federal Register, and until four weeks after the last notice.

d. The Commission, in issuing any license for a utilization or production facility for the generation of commercial power under section 103, shall give preferred consideration to applications for such facilities which will be located in high cost power areas in the United States if there are conflicting applications for a limited opportunity for such license. Where such conflicting applications resulting from limited opportunity for such license include those submitted by public or cooperative bodies such applications shall be given preferred consideration.

SEC. 183. TERMS OF LICENSES.—Each license shall be in such form and contain such terms and conditions as the Commission may, by rule or regulation, prescribe to effectuate the provisions of this Act, including the following provisions:

a. Title to all special nuclear material utilized or produced by facilities pursuant to the license, shall at all times be in the United States.

b. No right to the special nuclear material shall be conferred by the license except as defined by the license.

c. Neither the license nor any right under the license shall be assigned or otherwise transferred in violation of the provisions of this Act.

d. Every license issued under this Act shall be subject to the right of recapture or control reserved by section 108, and to all of the other provisions of this Act, now or hereafter in effect and to all valid rules and regulations of the Commission.

SEC. 184. INALIENABILITY OF LICENSE.—No license granted hereunder and no right to utilize or produce special nuclear material granted hereby shall be transferred, assigned or in any manner disposed of, either voluntarily or involuntarily, directly or indirectly, through

transfer of control of any license to any person, unless the Commission shall, after securing full information, find that the transfer is in accordance with the provisions of this Act, and shall give its consent in writing. The Commission may give such consent to the creation of a mortgage, pledge, or other lien upon any facility owned or thereafter acquired by a licensee, or upon any leasehold or other interest in such property, and the rights of the creditors so secured may thereafter be enforced by any court subject to rules and regulations established by the Commission to protect public health and safety and promote the common defense and security.

SEC. 185. CONSTRUCTION PERMITS.—All applicants for licenses to construct or modify production or utilization facilities shall, if the application is otherwise acceptable to the Commission, be initially granted a construction permit. The construction permit shall state the earliest and latest dates for the completion of the construction or modification. Unless the construction or modification of the facility is completed by the completion date, the construction permit shall expire, and all rights thereunder be forfeited, unless upon good cause shown, the Commission extends the completion date. Upon the completion of the construction or modification of the facility, upon the filing of any additional information needed to bring the original application up to date, and upon finding that the facility authorized has been constructed and will operate in conformity with the application as amended and in conformity with the provisions of this Act and of the rules and regulations of the Commission, and in the absence of any good cause being shown to the Commission why the granting of a license would not be in accordance with the provisions of this Act, the Commission shall

thereupon issue a license to the applicant. For all other purposes of this Act, a construction permit is deemed to be a "license".

SEC. 186. REVOCATION.—

a. Any license may be revoked for any material false statement in the application or any statement of fact required under section 182, or because of conditions revealed by such application or statement of fact or any report, record, or inspection or other means which would warrant the Commission to refuse to grant a license on an original application, or for failure to construct or operate a facility in accordance with the terms of the construction permit or license or the technical specifications in the application, or for violation of, or failure to observe any of the terms and provisions of this Act or of any regulation of the Commission.

b. The Commission shall follow the provisions of section 9(b) of the Administrative Procedure Act in revoking any license.

c. Upon revocation of the license, the Commission may immediately retake possession of all special nuclear material held by the licensee. In cases found by the Commission to be of extreme importance to the national defense and security or to the health and safety of the public, the Commission may recapture any special nuclear material held by the licensee or may enter upon and operate the facility prior to any of the procedures provided under the Administrative Procedure Act. Just compensation shall be paid for the use of the facility.

SEC. 187. MODIFICATION OF LICENSE.—The terms and conditions of all licenses shall be subject to amendment, revision, or modification, by reason of amendments of this Act or by reason of rules and regulations issued in accordance with the terms of this Act.

SEC. 188. CONTINUED OPERATION OF FACILITIES.—Whenever the Commission finds that the public convenience and necessity or the

production program of the Commission requires continued operation of a production facility or utilization facility the license for which has been revoked pursuant to section 186, the Commission may, after consultation with the appropriate regulatory agency, State or Federal, having jurisdiction, order that possession be taken of and such facility be operated for such period of time as the public convenience and necessity or the production program of the Commission may, in the judgment of the Commission, require, or until a license for the operation of the facility shall become effective. Just compensation shall be paid for the use of the facility.

SEC. 189. HEARINGS AND JUDICIAL REVIEW.—

a. In any proceeding under this Act, for the granting, suspending, revoking, or amending of any license or construction permit, or application to transfer control, and in any proceeding for the issuance or modification of rules and regulations dealing with the activities of licensees, and in any proceeding for the payment of compensation, an award or royalties under sections 153, 157, 186 c., or 188, the Commission shall grant a hearing upon the request of any person whose interest may be affected by the proceeding, and shall admit any such person as a party to such proceeding. The Commission shall hold a hearing after thirty days' notice and publication once in the Federal Register on each application under section 103 or 104 b. for a license for a facility, and on any application under section 104 c. for a license for a testing facility.

(b) Any final order entered in any proceeding of the kind specified in subsection a. above shall be subject to judicial review in the manner prescribed in the Act of December 29, 1950, as amended (ch. 1189, 64 Stat. 1129), and to the provisions of section 10 of the Administrative Procedure Act, as amended.

* * * * * *

SEC. 201. MEMBERSHIP.—There is hereby established a Joint Committee on Atomic Energy to be composed of nine Members of the Senate to be appointed by the President of the Senate, and nine Members of the House of Representatives to be appointed by the Speaker of the House of Representatives. In each instance not more than five Members shall be members of the same political party.

SEC. 202. AUTHORITY AND DUTY.—The Joint Committee shall make continuing studies of the activities of the Atomic Energy Commission and of problems relating to the development, use, and control of atomic energy. During the first sixty days of each session of the Congress, the Joint Committee shall conduct hearings in either open or executive session for the purpose of receiving information concerning the development, growth, and state of the atomic energy industry. The Commission shall keep the Joint Committee fully and currently informed with respect to all of the Commission's activities. The Department of Defense shall keep the Joint Committee fully and currently informed with respect to all matters within the Department of Defense relating to the development, utilization, or application of atomic energy. Any Government agency shall furnish any information requested by the Joint Committee with respect to the activities or responsibilities of that agency in the field of atomic energy. All bills, resolutions, and other matters in the Senate or the House of Representatives relating primarily to the Commission or to the development, use, or control of atomic energy shall be referred to the Joint Committee. The members of the Joint Committee who are Members of the Senate shall from time to time report to the Senate, and the members of the Joint Committee who are Members of the House of Representatives shall from time to time re-

port to the House, by bill or otherwise, their recommendations with respect to matters within the jurisdiction of their respective Houses which are referred to the Joint Committee or otherwise within the jurisdiction of the Joint Committee.

SEC. 203. CHAIRMAN.—Vacancies in the membership of the Joint Committee shall not affect the power of the remaining members to execute the functions of the Joint Committee, and shall be filled in the same manner as in the case of the original selection. The Joint Committee shall select a Chairman and a Vice Chairman from among its members, at the beginning of each Congress. The Vice Chairman shall act in the place and stead of the Chairman in the absence of the Chairman. The Chairmanship shall alternate between the Senate and the House of Representatives with each Congress, and the Chairman shall be selected by the Members from that House entitled to the Chairmanship. The Vice Chairman shall be chosen from the House other than that of the Chairman by the Members from that House.

SEC. 204. POWERS.—In carrying out its duties under this Act, the Joint Committee, or any duly authorized subcommittee thereof, is authorized to hold such hearings or investigations, to sit and act at such places and times, to require, by subpena or otherwise, the attendance of such witnesses and the production of such books, papers, and documents, to administer such oaths, to take such testimony, to procure such printing and binding, and to make such expenditures as it deems advisable. The Joint Committee may make such rules respecting its organization and procedures as it deems necessary: *Provided, however,* That no measure or recommendation shall be reported from the Joint Committee unless a majority of

the committee assent. Subpenas may be issued over the signature of the Chairman of the Joint Committee or by any member designated by him or by the Joint Committee, and may be served by such person or persons as may be designated by such Chairman or member. The Chairman of the Joint Committee or any member thereof may administer oaths to witnesses. The Joint Committee may use a committee seal. The provisions of sections 102 to 104, inclusive, of the Revised Statutes, as amended, shall apply in case of any failure of any witness to comply with a subpena or to testify when summoned under authority of this section. The expenses of the Joint Committee shall be paid from the contingent fund of the Senate from funds appropriated for the Joint Committee upon vouchers approved by the Chairman. The cost of stenographic service to report public hearings shall not be in excess of the amounts prescribed by law for reporting the hearings of standing committees of the Senate. The cost of stenographic service to report executive hearings shall be fixed at an equitable rate by the Joint Committee. Members of the Joint Committee, and its employees and consultants, while traveling on official business for the Joint Committee, may receive either the per diem allowance authorized to be paid to Members of Congress or its employees, or their actual and necessary expenses provided an itemized statement of such expenses is attached to the voucher.

SEC. 205. STAFF AND ASSISTANCE.—The Joint Committee is empowered to appoint and fix the compensation of such experts, consultants, technicians, and staff employees as it deems necessary and advisable. The Joint Committee is authorized to utilize the services, information, facilities, and personnel of the departments and establishments of the Govern-

ment. The Joint Committee is authorized to permit such of its members, employees, and consultants as it deems necessary in the interest of common defense and security to carry firearms while in the discharge of their official duties for the committee.

SEC. 206. CLASSIFICATION OF INFORMATION.—The Joint Committee may classify information originating within the committee in accordance with standards used generally by the executive branch for classifying Restricted Data or defense information.

SEC. 207. RECORDS.—The Joint Committee shall keep a complete record of all committee actions, including a record of the votes on any question on which a record vote is demanded. All committee records, data, charts, and files shall be the property of the Joint Committee and shall be kept in the offices of the Joint Committee or other places as the Joint Committee may direct under such security safeguards as the Joint Committee shall determine in the interest of the common defense and security.

2. The regulations of the Atomic Energy Commission, 10 CFR, provide in pertinent part:

SECTION 2.102 *Action on applications, hearings.* (a) The AEC will, upon request of the applicant or an intervener, and may upon its own initiative, direct the holding of a formal hearing prior to taking action on the application. If no prior formal hearing has been held and no notice of proposed action has been served as provided in paragraph (b) of this section, AEC will direct the holding of a formal hearing upon receipt of a request therefor from the applicant or an intervener within 30 days after the issuance of a license or other approval or a notice of denial.

(b) In such cases as it deems appropriate, AEC may cause to be served upon the applicant, and published, a notice of proposed action upon his application and shall cause copies thereof to be served upon interveners or others entitled to or requesting notification. The notice shall state the terms of the proposed action. If a formal hearing has not been held prior to issuance of the notice, AEC will direct the holding of a formal hearing upon the request of the applicant or an intervener received within fifteen days following the service of the notice.

* * * * *

SECTION 50.34 *Contents of applications; technical information. hazards summary. report.* Each application shall state the following technical information:

(a) A description of the chemical, physical, metallurgical, or nuclear process to be performed, and a statement of the kind and quantity of any radioactive effluent expected to result from the process. The description of the process should be sufficiently detailed to permit evaluation of the radioactive hazards involved. The magnitude of the proposed operation should be indicated in terms of the amount and radioactivity of source, special nuclear, or by-product material to be handled per unit of time, and thermal power to be generated if any.

(b) A description of the facility. The description should be based on the design criteria for the facility as a whole and for those major component parts which are essential to the safe operation of the facility, and should be presented in suffieent detail to allow an evaluation of the adequacy of the various means proposed to minimize the probability of danger from radioactivity to persons both on and off-site. The description should also cover any activities, other than those subject to license, proposed to be carried on in the building which will house the facility and on the balance of the site.

(c) A description of the site on which the facility is to be located. This should include a map of the area showing the location of the site and indicating the use to which the surrounding land is put, i.e., industrial, commercial, agricultural, residential; location of sources of potable or industrial water supply, watershed areas and public utilities; and a scale plot plan of the site showing the proposed location of the facility.

(d) A description of proposed procedures for: routine and non-routine operations, start-up and shut-down, maintenance, storage, training of employees, minimizing operational mishaps (such as locked controls, checklists, and close supervision), investigating unusual or unexpected incidents; and a description of such other details as may be useful in evaluating the existence and effectiveness of safeguards against the radioactive hazards in the operation of the facility.

(e) A description of plans or proposals in the event that acts or accidents occur which would create radioactive hazards. The description should relate the various operational procedures, the protective devices, and the pertinent features of the site, to such happenings as operational mistakes, equipment or instrument failure or malfunction, fire, electric power failure, flood, earthquake, storm, strike, and riot.

(f) Meteorological, hydrological, geological, and seismological data necessary for evaluating the measures proposed for protecting the public against possible radioactive hazards.

(g) An evaluation of the proposed measures and devices to prevent acts or accidents which would create radioactive hazards or to protect against the consequences should such acts or accidents occur.

(h) A description of procedures for disposal of radioactive solid waste and the final disposal of liquid waste effluent.

(i) A description of means provided to sample atmosphere discharges through stacks where such stacks may emit by-product material or special nuclear material.

SECTION 50.35 *Extended time for providing technical information.* Where, because of the nature of a proposed project, an applicant is not in a position to supply initially all of the technical information otherwise required to complete the application, he shall indicate the reason, the items or kinds of information omitted, and the approximate times when such data will be produced. If the Commission is satisfied that it has information sufficient to provide reasonable assurance that a facility of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public and that the omitted information will be supplied, it may process the application and issue a construction permit on a provisional basis without the omitted information subject to its later production and an evaluation by the Commission that the final design provides reasonable assurance that the health and safety of the public will not be endangered.

* * * * *

SECTION 50.40 *Common standards.* In determining that a license will be issued to an applicant the Commission will be guided by the following considerations:

(a) The processes to be performed, the operating procedures, the facility and equipment, the use of the facility, and other technical specifications, or the proposals in regard to any of the foregoing collectively provide reasonable assurance that the applicant will com-

ply with the regulations in this chapter, including the regulations in Part 20, and that the health and safety of the public will not be endangered.

(b) The applicant is technically and financially qualified to engage in the proposed activities in accordance with the regulations in this chapter.

(c) The issuance of a license to the applicant will not, in the opinion of the Commission, be inimical to the common defense and security or to the health and safety of the public.

* * * * *

APPENDIX B

Relation to Population Centers of Power Reactors in Operation or Under Construction [1]

A. LICENSED REACTORS

1. Commonwealth Edison Co., Morris, Ill., operating license issued, 626,000 thermal kilowatts: 14 miles from Joliet, 47 miles southwest of downtown Chicago; population within 5 miles—2,600, within 25 miles—192,000.

2. General Electric Co., Vallecitos, Calif., operating license issued, 30,000 thermal kilowatts: 33 miles east-southeast of San Francisco; population within 10 miles—22,000, within 25 miles—250,000.

3. Yankee Atomic Electric Co., R[redacted] Mass., operating license issued, 392,000 thermal kilowatts: within 20 miles of Bennington, Vt., and Adams, Greenfield and

[1] Population figures are taken from applications filed with the Commission to initiate licensing proceedings (for licensed facilities), or technical reports used in authorization proceedings (for Commission-owned reactors to be operated by local public bodies), constituting public documents of the Commission. The Shippingport data is taken from a Commission publication in 1957, WAPD-SC-547 describing the plant and surrounding area.

The reactors' capacities in thermal kilowatts are given as estimated on the best available information in the Commission's February 1960 report to the Joint Committee on Atomic Energy, in connection with the annual hearings on the atomic energy industry under Section 202 of the Act. Hearings on the Development, Growth and State of the Atomic Energy Industry Before the Joint Committee on Atomic Energy, 86th Cong., 2d Sess., p. 579.

North Adams, Mass., 40 miles east of Albany; population within 5 miles—2,036, within 20 miles—104,293.

4. Carolinas-Virginia Nuclear Power Associates, Inc., Parr, S.C., construction permit issued, 60,500 thermal kilowatts: 25 miles northwest of Columbia, S.C.; population within 5 miles—15 per square mile, within 10 miles—25 per square mile.

5. Consolidated Edison Co., Indian Point, N.Y., construction permit issued, 795,000 thermal kilowatts: 24 miles north of New York City; population within 5 miles—45,000.

6. Consumers Power Co., Big Point Rock, Mich., construction permit issued, 240,000 thermal kilowatts: 85 miles southwest of Sault Ste. Marie, 165 miles north of Grand Rapids; population within 5 miles—4,964, within 20 miles—26,700, within 40 miles—52,000.

7. Northern States Power Co., Sioux Falls, South Dakota, construction permit issued, 203,000 thermal kilowatts: 5.5 miles from center of Sioux Falls; population within 5 miles—10,000, within 10 miles—60,000, within 40 miles—175,000.

8. Power Reactor Development Co., Lagoona Beach, Michigan, construction permit issued, 304,000 thermal kilowatts: 30 miles from Detroit; population within 5 miles—1,800, within 20 miles—187,000, within 30 miles—2,001,700.

9. Saxton Nuclear Experiment Corp., Saxton, Pennsylvania, construction permit issued, 20,000 thermal kilowatts: 22 miles south of Altoona, Pa., 90 miles west of Harrisburg, 100 miles east of Pittsburgh; population within 5 miles—5,627, within 10 miles—18,303.

10. Pacific Gas & Electric Co., Humboldt County, California, construction permit issued, 163,000 thermal kilowatts: 4 miles southwest of Eureka; population within 5 miles—40,500, within 25 miles—77,740.

B. GOVERNMENT-OWNED REACTORS

1. Shippingport Atomic Power Station, Shippingport, Pa., in operation, 231,000 thermal kilowatts: 25 miles from Pittsburgh (30 miles from center of Pittsburgh); population within 5 miles—20,000, within 15 miles—225,000, within 40 miles—2,800,000.

2. Consumers Public Power District, Hallam, Nebr., provisional construction authorization, 254,000 thermal kilowatts: 19 miles south of Lincoln, 65 miles southwest of Omaha; population within 5 miles—1,052, within 10 miles—6,678.

3. City of Piqua, Ohio at outskirts of Piqua, provisional construction authorization, 45,500 thermal kilowatts: 28 miles north of Dayton, 70 miles north of Cincinnati; population within 5 miles—21,000, within 25 miles—108,000.

4. Rural Cooperative Power Association, Elk River, Minn., provisional construction authorization, 73,000 thermal kilowatts: 20–35 miles northwest of St. Paul-Minneapolis; population within 5 miles—2,656, within 10 miles—7,700.

5. Puerto Rico Water Resources Authority, Punta Higuera, Puerto Rico, provisional construction authorization, 50,000 thermal kilowatts: 13 miles northwest of Mayaguez; population within 2 miles—1,400, within 15 miles—173,000.

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Supreme Court of the United States

BRIEF FOR PETITIONER POWER REACTOR DEVELOPMENT COMPANY

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Supreme Court of the United States

OCTOBER TERM, 1960

No. 315

POWER REACTOR DEVELOPMENT COMPANY, *Petitioner*,

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL-CIO, *et al.*, *Respondents*

ON WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

BRIEF FOR PETITIONER POWER REACTOR DEVELOPMENT COMPANY

This case is before the Court on writ of certiorari (364 U.S. 889) to review a judgment of the United States Court of Appeals for the District of Columbia Circuit of June 10, 1960 (R. 969). A majority of a division of that court (Circuit Judges Edgerton and Bazelon, with Circuit Judge Burger dissenting) ordered to be set aside a unanimous decision and order of the Atomic Energy Commission which had continued in effect, subject to further proceedings, a provisional construction permit for a developmental power reactor being constructed by petitioner, Power Reactor Development Company (hereinafter called "PRDC"). Respondents did not urge that the findings of the Commission, made in accordance with its regulations and settled practice, were unsupported by the evidence, and they were accordingly accepted by the court below. The court held, however, that such findings were insufficient to satisfy the requirements of the Atomic Energy Act of 1954.

OPINIONS BELOW

The opinion of Circuit Judges Edgerton and Bazelon (R. 954) and the dissenting opinion of Circuit Judge Burger (R. 965) of the United States Court of Appeals for the District of Columbia Circuit are reported at 280 F.2d 645. The findings of fact and final opinion and decision of the Atomic Energy Commission are not reported. They are contained in the printed record at R. 630. The initial opinion and decision of the Commission are contained in the record at R. 607, 918.[1]

JURISDICTION

The judgment of the United States Court of Appeals for the District of Columbia Circuit was entered June 10, 1960 (R. 969). Timely petitions for rehearing *en banc* by both the Government and PRDC were denied on July 25, 1960, Judges Miller and Bastian dissenting and Judges Washington and Burger not participating (R. 970-71). PRDC filed a petition for writ of certiorari on August 12, 1960 (No. 315), and the United States and the Atomic Energy Commission filed a petition for writ of certiorari on September 29, 1960 (No. 454). On November 14, 1960, this Court granted both writs of certiorari, limited to the first two questions presented in the petitions, and consolidated the

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[1] Record citations herein ("R. ——") are to the three volumes containing excerpts from the certified transcript of record before the Commission and the court below which have been printed pursuant to stipulation for the use of this Court. References to record pages are to those listed at the bottom of the pages of Volumes I and II of this printed record, and at the top of the pages of Volume III. Volumes I and II were initially printed as joint appendices for the use of the court below, and the black letter numbers at the top of the pages of these two volumes accordingly refer to folio pages of the unprinted record before the Commission.

The entire transcript of record before the Commission, as certified by its Secretary to the Clerk of the Court of Appeals, consists of some 7034 folio pages in 17 volumes, and has been filed with the Clerk of this Court. A detailed index to this transcript is contained in the first volume thereof.

cases for oral argument (R. 972, 973, 364 U.S. 889). The jurisdiction of this Court is invoked under 28 U.S.C. § 1254(1).

QUESTIONS PRESENTED

1. In accordance with its uniform practice, the Atomic Energy Commission issued to petitioner PRDC a "provisional" construction permit authorizing construction (but not start-up or operation) of a developmental nuclear reactor. The Commission's order modifying and continuing this provisional permit in effect after a hearing was supported by findings of fact provided for in Section 50.35 of its regulations that for such purpose there was reasonable assurance that a facility "of the general type proposed" could be constructed and operated at its location without undue risk to the health and safety of the public. On petition for review, the Court of Appeals for the District of Columbia Circuit held such findings insufficient to satisfy the requirements of the Atomic Energy Act of 1954. The first question presented is whether, as the court held, the Commission lacks authority under the Act to issue reactor construction permits on the basis of the findings called for by its regulation, and whether such regulation and the Commission's settled practice thereunder are accordingly invalid.

2. The Commission here made findings of fact that the site chosen was suitable for a reactor of the size and type proposed, subject to adequate demonstration that the particular reactor as completed could be safely operated, and these findings were not attacked as unsupported by the evidence. As an alternative ground of decision, however, the court below held such findings inadequate because it construed the Atomic Energy Act generally, in the absence of any specific statutory provision on the point, as requiring a further finding of "compelling reasons" for selection of a site for any power reactor located within a moderate distance (30 miles) of a substantial city. In this respect the location of the PRDC reactor is generally comparable to that of other power reactors heretofore authorized by the Commission. The second question presented is whether,

as the court held, the Commission is without power under the Act to authorize construction of nuclear reactors within such moderate distances of populated centers without finding "compelling reasons" therefor, and whether, indeed, as the decision below implies, no reasons can be sufficiently compelling, regardless of the technical safeguards provided, to justify location of such licensed reactors in any but remote areas.

STATUTES AND REGULATIONS INVOLVED

The pertinent provisions of the Atomic Energy Act of 1954, 68 Stat. 919, as amended, 42 U.S.C. § 2011 *et seq.*, and of Sections 50.34 and 50.35 of the Atomic Energy Commission's regulations (10 CFR §§ 50.34, 50.35), are set forth in the Appendix to this Brief (pp. 70-81).

STATEMENT

The Nature of the Project

PRDC is a non-profit membership corporation, organized under the laws of Michigan. It has 31 member companies: seven are industrial corporations,[2] 13 are operating public utility companies, and one is a service company representing four additional public utility operating companies.[3] PRDC's corporate purpose is to do research and development work on nuclear electric power, and to make information acquired from such activity available not only

[2] Allis-Chalmers Mfg. Co.; The Babcock & Wilcox Co.; Burroughs Corp.; Combustion Engineering, Inc.; Fruehauf Trailer Co.; Holley Carburetor Co.; Westinghouse Electric Corp. (R. 722-23).

[3] Central Hudson Gas & Electric Corp.; The Cincinnati Gas & Electric Co.; The Columbus and Southern Ohio Electric Co.; Consumers Power Co.; Delaware Power & Light Co.; The Detroit Edison Co.; Iowa-Illinois Gas and Electric Co.; Long Island Lighting Co.; Philadelphia Electric Co.; Potomac Electric Power Co.; Rochester Gas and Electric Corp.; The Toledo Edison Co.; Wisconsin Electric Power Co.; and Southern Services, Inc., representing The Southern Co. and its following four operating subsidiaries: Alabama Power Co.; Georgia Power Co.; Gulf Power Co.; Mississippi Power Co. (R. 722-23; Opinion, R. 681-82, n. 69).

to its members but also to the Atomic Energy Commission for the use of the public, and to all others who may desire such information. It is carrying out this purpose through the design and construction of a full scale developmental "fast neutron breeder reactor" at a large site located in a rural area in Monroe County, Michigan, about 30 miles southwest of Detroit. The entire project, including associated electric generating facilities being constructed by The Detroit Edison Company, is known as the Enrico Fermi Atomic Power Plant.

As a "developmental project" the proposed Enrico Fermi plant will not be, and is not intended to be, an economic or commercial success of economically competitive with conventional power plants. See AEC Opinion, R. 685-86. As the Commission found, the reactor is essentially "a research and development facility" (Finding 2, R. 701). The project's basic objective is to explore, by actual construction and eventual operation, the feasibility and cost of using this type of reactor for the central station generation of electric power. It is anticipated that the design, engineering and operating information thus obtained will be of utility in enabling second or third generations of such reactors to approach economically feasible power. In accordance with this concept, the member companies of PRDC have no capital investment as such in it. The financial contributions made by the member companies are treated by them as having been expended for research and development at the time they are put into the project and not as having been invested or capitalized. No return on or repayment of these contributions can be had, regardless of the outcome of the project.[1]

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[1] PRDC's articles of incorporation provide specifically that no part of any net earnings may inure to the benefit of any member, individual or corporation and that its members may receive nothing even on dissolution, since in that case, any remaining assets must be turned over to an organization or organizations operated exclusively for educational or scientific purposes (R. 723; R. 387-89).

Characteristics of Power Reactors and the Theoretical or Potential Hazards Associated with Them

Certain materials, including some forms of the element uranium, are "fissionable." This means that, when sufficiently bombarded by subatomic particles called "neutrons," their atoms split apart or "fission" into atoms of other lighter elements ("fission products"), and at the same time release great quantities of energy and additional neutrons. If these neutrons in turn are used to bombard other atoms of the fissionable material, the latter will then split up in the same way, releasing still more energy and further neutrons. This, considerably oversimplified, is the atomic chain reaction which is the source of all nuclear energy. A reactor is simply a device designed to facilitate, control and utilize this chain reaction.

As the Commission stated in its opinion, the PRDC reactor, like all other contemporary power reactors, is one in which the heat energy derived from the atomic fissions is removed by a circulating coolant in such a way as to generate steam. This steam operates a conventional turbine-generator which makes electric power (Opinion, R. 666-69). The extent to which the nuclear fissions take place, which in turn determines the rate at which energy is released, is dependent among other things on the flux or density of the neutrons in the reactor. The atomic chain reaction can be started, stopped and otherwise controlled by movable rods containing a material such as boron carbide which, when inserted into the reactor, absorbs neutrons and so reduces the fission activity and the heat or power being developed by the reactor. If the reactor is designed to use neutrons moving at or about their initial speed of some 8,000 to 10,000 miles per second, it is called a "fast-neutron" reactor, or, more briefly, a "fast" reactor.[3]

[3] If, however, the reactor employs a "moderator" such as graphite, water, or beryllium, which has the ability to slow down neutrons to a speed of about one mile per second without absorbing those neutrons, and if the reactor employs those relatively slow-

The PRDC reactor is to be a liquid-sodium-cooled "fast breeder" reactor capable of producing the heat energy required to operate electric generating facilities with a capacity of 100,000 kilowatts of electricity. It will use as its fuel or "fissionable material", uranium metal in which the uranium-235 isotope has been artificially concentrated and which is therefore called "enriched" uranium.[3] The enriched "core" of the reactor, which produces most of the heat, is surrounded by a "blanket" of the more common non-fissionable uranium-238.

A unique and important feature of the basic design is that a relatively substantial amount of the uranium-238 in the reactor will, by absorption or "capture" of fast neutrons, be transformed in the course of operation to plutonium, a heavier man-made element not found in nature. This plutonium, like uranium-235, is itself a fissionable material, potentially capable of being used as a reactor fuel. The number of atoms of plutonium which will be so created in the normal operation of the reactor will exceed the number of atoms of uranium-235 which will be utilized or "burned up." This is the characteristic of the reactor

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moving nuclear particles in the chain reaction, it is called a slow or "thermal" reactor. See Opinion, R. 668, n. 51.

[3] See also general discussion of how a reactor works in testimony of Dr. Lawrence R. Hafstad, then director of AEC Reactor Division, in *Hearings Before the Joint Committee on Atomic Energy on Atomic Power Development and Private Enterprise*, 83d Cong., 1st Sess. (1953), pp. 13-22.

[4] An isotope may be defined as "one of two or more species of the same element, having almost identical chemical properties but differing in atomic weight". *Atomic Energy Facts* (GPO, 1957), p. 157. Only about 0.7 per cent of the uranium found in nature consists of the fissionable isotope uranium-235; the rest is uranium-238, which is not readily fissionable under neutron bombardment and so is not usable as such as a reactor fuel.

[5] The concentration of the uranium-235 isotope to form "enriched uranium" is a difficult and expensive process, at present performed only in Commission facilities. *Id.* at pp. 68-70.

which makes it a "breeder."[7] The Commission here found that "demonstration of the economic practicability of breeding would increase by many times the available reserves of nuclear fuel by facilitating the conversion into plutonium and use as fuel the Uranium-238 isotope which comprises 99.3 per cent of the natural uranium" resources in the world (Finding 26, R. 709).

The general nature of the possible hazards associated with the operation of any type of large nuclear reactor is not disputed. There is no possibility of a blast or explosion comparable to that of an atomic bomb. The happening to be guarded against is rather the accidental release to the environment of the highly toxic radioactive "fission products" which result from the nuclear chain reaction and which are gradually accumulated in the fuel elements of the reactor; their quantity is primarily a function of the size or power of the particular reactor and the length of time for which it has operated without reloading of nuclear fuel (R. 739-42, 874-78, 901). If fully released to the environment, the fission products so built up in *any* reactor of substantial size could cause devastating damage (R. 71-73, 895-900). Both Congress in enacting the Atomic Energy Act of 1954[8] and the Commission in administering it[9] have shown that they are fully aware of the magnitude of this potential hazard and of the necessity for and availability of correspondingly complete means of protecting against it.

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[7] Dr. Hans A. Bethe, one of the world's leading nuclear physicists, stated in his testimony for PRDC in this proceeding that a breeder reactor can be likened to "a coal furnace which makes more coal than it uses up" (R. 737). Dr. Bethe's narrative testimony contains a more extensive but simple and lucid explanation of the basic principles of fast breeder reactors. See R. 735-39.

[8] See p. 59 below and *Hearings Before the Joint Committee on Atomic Energy on Atomic Power Development and Private Enterprise*, 83d Cong., 1st Sess. (1953), pp. 32-34, 59-60.

[9] See, *e. g.*, AEC study on "Theoretical Possibilities and Consequences of Major Accidents in Large Nuclear Power Plants" (sometimes called the "Brookhaven Report"), R. 874-917.

The Commission has made it clear that it accordingly will not permit the operation of this or any other reactor comparably located until there has been a showing that it is beyond the realm of credible possibility for an accident to the reactor as designed, built and tested to "release significant quantities of fission products into the atmosphere" (R. 707-08; see also R. 634-35, 646-47, 649-51, 676).[10] It should be emphasized that this ultimate and all-important safety question is not presented at this stage of the proceedings, since all that is authorized by the Commission's order here under review is construction, not operation of the reactor, and it is undisputed that construction alone presents no conceivable public hazard. Before the reactor can be operated at all there must be a further proceeding, including a *de novo* public hearing, on the question of whether operation of the reactor as finally designed and actually completed can be undertaken without undue risk to the public.

History of the Proceeding

On January 6, 1956, PRDC filed its application for license under Section 104 b of the Atomic Energy Act of 1954 for the construction and operation of its proposed nuclear reactor as a research and developmental project (R. 364).

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[10] The extreme lengths to which multiple layers of containment and other available protective measures are taken in order to render public injury incredible, and the extremely small probability of public injury from an accident to a reactor which is so protected, are indicated generally in Part I of the AEC "Brookhaven Report" (R. 879-86), and were summarized by the Joint Committee on Atomic Energy in its 1957 report recommending enactment of governmental indemnity legislation. Sen. Rep. No. 296, H. R. Rep. No. 435, 85th Cong., 1st Sess. (1957), pp. 2, 3. It was noted in both the AEC study (R. 884-85) and the Joint Committee report (p. 3) that the chance of a member of the public being killed by any of an assumed 100 large reactors operating in populated areas is only one in 50 million, which may be compared with the statistical chance of being killed by an automobile of one in 5,000.

On August 4, 1956, the Commission issued to PRDC a construction permit "on a provisional basis" under Section 50.35 of its regulations (R. 513, 586). This permit recited that there were areas of uncertainty with respect to the hazards potential of such a reactor that must be investigated and solved, and that the conversion of the construction permit to a license to operate the reactor was subject to submission and evaluation of a final "hazards summary report" which would adequately demonstrate the safety of the reactor as finally designed and built (R. 517). The construction permit itself as well as the Commission's covering letter of August 4, 1956, emphasized further that, while "the Commission believes that the safety problems associated with the reactor will prove to be of a kind which can be resolved within a reasonable time", the construction permit was "a conditional one" and the Commission could "make no commitment to convert the permit to a license until it is satisfied on all safety matters" (R. 514).[11]

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[11] The conditions included in this provisional construction permit and explained more fully in the Commission's covering letter reflected the recommendations which had been made several months before by the Commission's Advisory Committee on Reactor Safeguards in a letter to the General Manager of the Commission dated June 6, 1956 (R. 587-93). At that time the Advisory Committee had no statutory basis; its function was to provide to the Commission on request advice of a technical nature with respect to reactor safety problems. The letter concluded that there was not sufficient information available "at this time to give assurance that the PRDC reactor can be operated at this site without public hazard", outlined a suggested program of investigation needed to obtain the necessary information and urged the Commission itself to assist in providing "sufficient development facilities and experimental information that the safety aspects of the PRDC reactor can be reliably appraised in advance of operation of the reactor itself" (R. 587-93). The Advisory Committee did not recommend that construction of the reactor not be undertaken or that a provisional construction permit should not be issued to PRDC.

The "theoretical and experimental programs" recommended by

Within the 30 days provided by Section 2.102 of the Commission's regulations after issuance of this permit, respondent labor unions filed petitions to intervene in the proceeding. They opposed continuation of the permit on the ground that *operation* of the proposed reactor, following its completion, would create a hazard to them, their members, and their property in the general vicinity of Detroit, and that PRDC was not financially qualified to carry out the project (R. 524). The Commission set down for hearing the question of whether the permit should be continued, modified or vacated, but refused in its discretion to suspend it pending this hearing (R. 576). In its memorandum accompanying the order, the Commission found (and respondents have never disputed) that actual construction of the reactor—the only activity authorized by the provisional construction permit—presented no hazard to the respondents or the public (R. 582).

Following an extensive hearing before a hearing examiner, and briefs and oral argument before the Commission itself, the Commission entered an initial decision modifying and continuing the provisional construction permit in effect (R. 607, 918). After further consideration of exceptions filed by respondents (R. 939) and briefs by all parties, the Commission unanimously (Commissioners Vance, Floberg and Graham) entered its "Opinion and Final Decision" on May 26, 1959, affirming its initial decision and making extensive findings of fact (R. 630).

Construction of the reactor was commenced under the provisional construction permit in August, 1956, and has continued to go forward since that time. On November 18, 1960, the Commission for good cause shown extended the time stated in the construction permit for the completion of the facility from December 15, 1960 (R. 716), to July 15, 1961, subject to any final judgment which may be entered in these judicial review proceedings. A copy of this order has been lodged with the Clerk of this Court.

the Advisory Committee were instituted, and on the evidence adduced at the hearing the Commission here found reasonable assurance that they would successfully develop the necessary information (Finding 31, R. 710).

The Decision of the Commission

Section 182 a of the Atomic Energy Act of 1954 (Appendix, pp. 76-77) authorizes the Commission to prescribe "by rule or regulation" the information to be included in applications for licenses. Section 185 authorizes the issuance of construction permits to those seeking "licenses to construct or modify production or utilization facilities" [reactors] (Appendix, p. 78). Pursuant to these provisions as well as the more generalized authority contained in Section 161 i (3) to issue rules and regulations "to govern any activity authorized pursuant to this Act" (Appendix, p. 74), Section 50.34 of the Commission's regulations specifies the extensive technical information required to be included in applications for reactor licenses (Appendix, pp. 80-81). Section 50.35, entitled "Extended time for providing technical information", authorizes the issuance of construction permits "on a provisional basis", prior to submission of all technical data required by Section 50.34, in those cases where, "because of the nature of a proposed project" such data are not initially available. Issuance of such a provisional or conditional permit requires a finding by the Commission, *inter alia*, of "reasonable assurance that a facility *of the general type proposed* can be constructed and operated at the proposed location without undue risk to the health and safety of the public" (italics supplied; see full text of regulation in Appendix, p. 81 below). Issuance of an operating license is specifically subject to the later production by the applicant of the requisite additional technical information when it becomes available, and to the subsequent definitive determination by the Commission, after a hearing and before such license can be issued, that "the final design provides reasonable assurance that the health and safety of the public will not be endangered.". The provisional construction permit contemplated by this provision of the regulations thus authorizes only construction, and carries no presumption or implication that an operating license will follow, unless the applicant is later able to sustain the burden of adequately showing the safety of "the final

design", of the reactor, after a complete new safety review including a compulsory public hearing directed to this issue.

The Commission in its final opinion and decision here made the precise findings called for by its regulations. It found in the words of Section 50.35 that there was "reasonable assurance", for purposes of the provisional construction permit in question, that "a utilization facility of the general type proposed in the PRDC Application and amendments thereto can be constructed and operated at the location without undue risk to the health and safety of the public" (Finding 22, R. 708, and Opinion, R. 665; see also Finding 30, R. 710; Finding 32, R. 710-11). Respondents make no contention that these findings are not amply supported by the evidence.[12] In fact, the construction permits issued for every one of the eight other developmental power reactors authorized prior to the decision below were similarly "provisional" permits, issued under this regulation, and were supported by the same finding of reasonable assurance of safety in terms of "the general type proposed".[13] In support of its ultimate findings, the Commission here summarized and quoted extensively from the expert testimony on the safety of the general reactor type proposed, including testimony of several members of the Advisory Committee on Reactor Safeguards, noting that the witnesses were in surprisingly close agreement. See Opinion, R. 672-77.

In its opinion and decision the Commission made it perfectly clear that it interpreted Section 50.35 of its regulations as requiring a less definitive determination of safety

[12] In their final statement of the issues presented to the Court of Appeals (R. 951-53), respondents did not attack any of the Commission's site or safety findings as unsupported by the evidence. Respondents did urge to the Court of Appeals that those findings of the Commission with respect to PRDC's financial qualifications were not supported by the evidence and should be set aside. See Supplemental Statement of Issues, pars. 4, 5, R. 952-53. This latter issue, however, was not reached or considered by the court below.

[13] See projects listed in our petition for certiorari (No. 315), pp. 40-41; Government petition for certiorari (No. 454), pp. 61-64.

of operation for issuance of a "provisional" permit authorizing only construction than would be subsequently required to support issuance of an operating license:

> "The degree of 'reasonable assurance' with respect to safety that satisfies us in this case for purposes of the *provisional* construction permit would not be the same as we would require in considering the issuance of the *operating* license" (AEC Opinion, R. 679-80).

In fact, the establishment of this step-by-step licensing procedure was the very objective of the regulation, an objective made necessary by the nature and inherent characteristics of a developmental reactor in the setting of the present status of nuclear progress. See AEC Opinion, R. 676; and pp. 30-33, below. Accordingly, the Commission stated that, as Section 50.35 of its regulations contemplates, its determinations with respect to safety of operation were made for purposes only of the provisional construction permit. It emphasized that no decision was being made or implied on the issue of the definitive safety of this reactor *as completed* which would be presented in connection with the further proceedings required to be had before an operating license could issue. This issue, it made clear, would be judged by the necessarily more severe standards of reasonable assurance then called for (R. 649-50, 679-80).

Before there can be operation of the reactor, there must be a further analysis and public report on its safety by the Advisory Committee on Reactor Safeguards, and a further hearing in which PRDC will have the burden of proof and in which the respondents may participate. Following this, there must be a new decision by the Commission, on the record then made, with respect to the issue of safety of operation of the plant as it is finally completed and tested. As the Commission stated it,

> "Before we authorize the issuance of an operating license to PRDC at a further reopening of this proceeding, we will require that all safety questions be

answered to our complete satisfaction, as required by the statute and our regulations. Under such circumstances, the public interest and that of the Intervenor [respondents] have been protected" (R. 634-35).[14]

From the outset, PRDC has understood and accepted the fact that issuance of its provisional construction permit carries with it no implication whatever that an operating license will later be granted. It has explicitly recognized that, if it should be unable to sustain the burden of showing that the reactor as completed can be safely operated in accordance with the rigid standards of proof which are necessarily and properly required by the Commission for such determination, it would not be able to obtain authority to operate the reactor. In this case components of the reactor might then have to be redesigned, additional protective devices might have to be designed and built, or, conceivably, the reactor portion of the plant might have to be dismantled and scrapped, the project then having demonstrated a reactor of this design not to be feasible for its intended purpose. The assumption of the financial risks thus presented was knowingly accepted in this nonprofit research undertaking as an inevitable concomitant of progress in nuclear technology at this early stage of development of the art.[15]

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[14] An extensive and detailed procedure for continuing review of safety and financial questions was specifically provided for in the decision (R. 711-12), in the order entered (R. 713-14, 679-80), and in the terms of the amended construction permit itself (R. 717-19). In addition, Sections 182 b and 189 a of the Act (as amended in 1957, 71 Stat. 579) specifically require a new evaluation and report by the Advisory Committee on Reactor Safeguards and a formal hearing after notice and publication before an operating license can be issued.

[15] The Commission in its opinion stated that "it would be hard to imagine a case where an applicant would be less able to argue that he had been misled by previous favorable Commission action" (R. 650). See also pp. 51-53, below.

The Decision of the Court of Appeals

Respondent labor unions duly filed with the Court of Appeals for the District of Columbia Circuit a petition to review the Commission's decision under Section 189 b of the Atomic Energy Act and the provisions of the Judicial Review Act of December 29, 1950, as amended, and of the Administrative Procedure Act (R. 946, 951; 64 Stat. 1129, as amended, 5 U.S.C. §§ 1031 *et seq.*; 60 Stat. 243, 5 U.S.C. § 1009). On June 10, 1960, a majority of a division of that court reversed the Commission and ordered the provisional construction permit set aside on the ground that the findings made were insufficient to satisfy the statutory requirements.

The court held that under the Atomic Energy Act of 1954 the Commission was required to make the same finding with respect to safety of operation of a proposed reactor "as of the time the construction permit is issued" that it admittedly must make "when it authorizes operation" (R. 957). The court nowhere cited or discussed Section 50.35 of the Commission's regulations. As stated above, this regulation establishes a two-stage procedure calling for the issuance of a "provisional" construction permit on the basis of an initial finding of reasonable assurance of safety only "of the general type proposed," to be followed prior to issuance of an operating license by a more definitive finding, based upon evidence to be adduced in a further new hearing, that "the final design provides reasonable assurance that the health and safety of the public will not be endangered." Ignoring this regulation, the court held that the Commission must make initially the definitive finding admittedly required before operation, that the reactor can be operated at the proposed site without undue risk (R. 957).

The effect of the court's decision is necessarily to invalidate Section 50.35 of the Commission's regulations and the step-by-step licensing concept which it embodies. While admitting that there are strong practical and technical reasons behind the Commission's provisional construction permit policy (R. 962), the court interpreted the provi-

sions of Sections 182 a and 185 of the Act as depriving the Commission of authority to follow such procedure. Although the Commission's construction is entirely consistent with the specific language of these sections, (pp. 76-78, below), the court relied upon an isolated item selected from the extensive legislative history of the Act to support its own interpretation (R. 958-60) (pp. 37-47, below). It recognized that the meaning of the statutory provisions in question might be doubtful, but it resolved that doubt against the Commission, contrary to ordinary canons of statutory construction (R. 960).

Having concluded that the statute required a definitive and final determination of safety of operation as a prerequisite to issuance of any construction permit, the court then examined the Commission's findings and held them to be "ambiguous" in not clearly meeting this standard (R. 960-63). In fact, as the Commission's opinion makes abundantly clear, its findings did not purport to be definitive safety determinations in the sense required by the court's decision, since the plain provisions of Section 50.35 of the regulations called for such determination to be made only at a later stage of the proceedings. This is a stage which has not yet been reached, and at which a further public hearing on the ultimate question of safety of operation of the reactor as completed will be required, and a new comprehensive determination of this question made on the basis of the technical evidence then adduced.

The court rested its decision on the merits on an additional ground which has even more serious implications for effective administration of the Act and for the future of the country's nuclear development program. After quoting from statements in the introduction to a technical Commission study with respect to the "possible consequences" of "certain hypothetical major accidents" which might occur in "a typical large nuclear power reactor" (discussed at pp. 56-57, below), the court concluded, without referring to any identified statutory provision or to any specific item of legislative history, "that Congress intended

no reactor should, without compelling reasons, be located where it will expose so large a population to the possibility of a nuclear disaster" (R. 964). By adding the dictum that it need not now consider "whether even the most compelling reasons for preferring this location" could support a finding that the reactor could be operated there without undue risk (R. 965), the court indicated that its basic intent was, as a practical matter, to deter the Commission from approving the location of *any* large power reactor in an area having a population density comparable to that found here. The Commission, of course, has not here or in any other reactor licensing case considered it either necessary or appropriate to find "compelling reasons" for the selection of a particular location so long as it made the findings required by its regulations that the location was a suitable one, taking into consideration *all* factors, including the population distribution in the area.

Circuit Judge Burger vigorously dissented from all aspects of the court's decision. He considered the Commission's practice in issuing provisional construction permits fully consistent with the statute, stating that

> "In an area involving as much scientific uncertainty as development of nuclear energy for peaceful purposes, the Commission must be permitted to proceed step by step, *i.e.*, make its preliminary finding of probable safety when the construction permit issues and reserve final approval of operations until a later date" (R. 966).

Judge Burger further characterized that portion of the decision dealing with the suitability of the location of the reactor as an unwarranted assumption by the court of "responsibilities which Congress vested in the Commission" (*ibid.*). He accordingly thought that the petition for review should have been dismissed.

Following denial of petitions for rehearing *en banc*, an order staying transmission of the court's opinion and judgment pending application for certiorari was entered on

August 8, 1960 (R. 971). On November 14, 1960, this Court granted writs of certiorari (Nos. 315 and 454, 364 U.S. 889), limited to the two questions stated herein (pp. 3-4, *supra*).[18]

SUMMARY OF ARGUMENT

I

All agree that mere construction of a reactor—the only activity authorized by the Commission's order in question—presents no public safety question whatever. The court below has nevertheless held that the Atomic Energy Act of 1954 requires the Commission to make the same definitive findings with respect to safety of operation of a proposed reactor as a basis for issuing a provisional construction permit that admittedly must be made prior to issuance of an operating license (R. 957). Although the court nowhere cited or discussed Section 50.35 of the Commission's regulations, the inevitable effect of its decision is to invalidate this regulation and the step-by-step licensing procedure which it provides.

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[18] The third question decided by the court below (R. 956-57, 965-66) and presented in the petitions for certiorari was whether the Commission's order was "final" as to these respondents and sufficiently "aggrieved" thereby to make it reviewable under the applicable statutory provisions (60 Stat. 243, 5 U.S.C. § 1009; 64 Stat. 1129, as amended, 5 U.S.C. §§ 1031 *et seq.*; 68 Stat. 955, as amended, 42 U.S.C. § 2239). This question goes to the jurisdiction of the reviewing courts and so cannot be avoided if the questions presented on the merits are to be decided. *Federal Communications Commission* v. *National Broadcasting Co.*, 319 U.S. 239, 246; *United States* v. *Storer Broadcasting Co.*, 351 U.S. 192, 197. While the question is believed to be substantial, it will not be argued further here in view of this Court's order limiting the grant of certiorari to the questions on the merits (R. 972, 973, 364 U.S. 889). A discussion of this question is contained in our petition for certiorari (pp. 32-38), and in our brief (pp. 14-23) and petition for rehearing *en banc* (pp. 20-22) below, copies of which have been lodged with the Clerk of this Court.

A. The basic purposes of the Atomic Energy Act of 1954 were "to encourage widespread participation" by private industry "in the development and utilization of atomic energy for peaceful purposes" (Section 3 d, Appendix, p. 70), with priority to and a minimum of regulatory restriction on those research and development projects likely to lead to major advances in the application of atomic energy for industrial or commercial purposes (Section 104 b, Appendix, pp. 72-73). Within this directive the Commission was given broad authority by the licensing provisions of the Act contained in Sections 182 and 185 to regulate these projects so as to "provide adequate protection to the health and safety of the public", and to issue rules and regulations in accordance therewith (Section 161 b, i, and p, Appendix, p. 74). Section 182 a provides that "in connection with applications for licenses to operate" reactors, the Commission shall require the submission of such information as is necessary to enable it to find that such operation will be safe (Appendix, pp. 76-77). Section 185 provides for issuance of construction permits if the application therefor "is otherwise acceptable to the Commission" (Appendix, p. 78).

B. In implementing these statutory provisions the Commission was plainly aware, as it found here, that at the present stage of nuclear technology the process of constructing an advanced developmental reactor is itself an integral part of the development of its final design, required for definitive assessment of the safety with which it can be operated (pp. 30-33, below). To give effect to this fundamental technological fact while at the same time providing adequate protection to the public safety and discouraging expenditure on proposals of little promise, the Commission developed the provisional construction permit procedure embodied in Section 50.35 of its regulations.

This regulation (Appendix, p. 81) provides for the issuance in appropriate cases of construction permits "on a provisional basis" if the applicant can show "reasonable assurance" that a reactor "of the general type proposed" can be operated at the proposed site "without undue risk

to the health and safety of the public" and that any further necessary information "will be supplied". Such a provisional permit is expressly subject to the later determination, prior to authorization of operation, that "the final design provides reasonable assurance that the health and safety of the public will not be endangered". This regulatory scheme is fully consistent with the statutory licensing provisions; the wording of Section 182 a makes it clear that it is in connection with applications for licenses "to operate" reactors that the Commission must make the definitive determination of safety of such operation, and Section 185 authorizing construction permits contains provisions that contemplate both the submission of further information as construction progresses and a final safety determination by the Commission on the basis thereof (Appendix, pp. 76-78). These provisions on their face thus call for rather than forbid the type of regulatory structure erected on them by the Commission in Section 50.35 of its regulations.

C. The Commission made the precise findings required by this regulation, that there is "reasonable assurance" of safety of "the general type" of reactor proposed (R. 708, and pp. 34-35, below). Both in these findings and in its accompanying opinion it made clear that its regulation contemplates that this safety determination of the general reactor concept is necessarily made on the basis of a lesser degree of reasonable assurance than will later be required with respect to "the final design", prior to issuance of an operating license (R. 679). That the degree of reasonable assurance of safety required to be shown for the general design concept is inherently of a different order than that which can and must later be shown for the reactor as finally built and tested is fundamental to the Commission's regulatory scheme. The decision of the court below, holding issuance of a provisional construction permit on this basis to be beyond the Commission's statutory authority, overturns this basic regulatory structure. The further statement of the court below that the Commission's findings were "ambiguous" (R. 963) similarly stems from

its erroneous premise that a definitive finding with respect to the safety of the particular design initially submitted is required before a provisional construction permit can be issued. The findings made did not purport to meet such a standard.

D. Nothing in the legislative history of the Atomic Energy Act of 1954 justifies this limitation on the Commission's authority. The exchange between Senator Humphrey and Senator Hickenlooper to the effect that "a license and construction permit are equivalent" (relied upon by the court below, R. 958-60) must be considered in the light of the several specific amendments to which it was related and of the controversy over public power policy of which it was a part. A careful consideration of the amendments then under discussion and their setting shows that neither participant in this colloquy was considering the question of safety determinations or the stage of the proceeding at which they should be required to be made (pp. 37-47, below).

E. Finally, the provisional construction permit procedure followed by the Commission here and in other power reactor license cases represents an appropriate exercise by the Commission of the responsibility delegated to it by Congress. The Commission's regulation and consistent practice thereunder have been repeatedly brought to the attention of Congress, which, while amending the Act with respect to certain other aspects of reactor licensing, has made no attempt to alter the Commission's basic two-step approach. The court below not only ignored this legislative acquiescence in the Commission's interpretation but, contrary to the accepted rule (*United States* v. *American Trucking Associations, Inc.*, 310 U.S. 534, 549), it resolved its doubts as to the Act's meaning against that interpretation, on the mistaken assumption that such resolution was "on the side of safety" (R. 960). In fact, the question of the safety of this reactor is not presented at all at this stage of the proceedings, and if developmental reactors are to be built as Congress contemplated, it is very dubious whether

public safety would in the long run be promoted by the rigid rule enunciated by the court below that the definitive safety determination of every reactor is required to be made prior to construction rather than in connection with start-up and operation.

II

As an alternative ground of decision, the court below held the Commission's findings that the site is a suitable one for such a reactor to be deficient because of a failure to find "compelling reasons" for the selection of a location within a moderate distance (30 miles) of a substantial city (R. 964). This holding was expressly stated to be applicable to any large power reactor and was not related to any unique characteristics of this particular project. In reaching its conclusion, the court cited no specific portions of the statute or its legislative history as requiring or justifying this limitation on the Commission's authority to approve reactor locations. Rather, it relied upon statements with respect to the maximum potential damage which could result from a large reactor accident, as reported to Congress in a Commission study in 1957 (R. 349-56, 894-900), without considering also the conclusions stated in the same study with respect to the availability of adequate protection which could be provided against such dangers and the extraordinarily remote possibility of such an occurrence (R. 879-86, 901-14).

A. The population distribution around the site was considered by the court below to be its single disqualifying factor (R. 964-65). The reactor is located on a large plot in an essentially rural area (R. 706-07). The distribution of population in the vicinity of the site is generally comparable to that of other demonstration power reactors constructed or licensed by the Commission. The location of several of these projects was specifically considered during hearings and debates on the Atomic Energy Act of 1954 (pp. 60-61, below). The legislative history also shows that Congress at that time was plainly aware of the extent of the possible damage which could result from

a reactor accident, as well as of the availability of means to prevent such damage from occurring (pp. 59-60, below). With all this before it, Congress chose to grant to the Commission broad authority with respect to reactor location as well as other factors to be weighed in carrying out its statutory duty to provide adequate protection to public health and safety, rather than to impose rigid statutory limitations on site selection.

B. The Commission's consistent practice since enactment of the 1954 Act in licensing (and in building itself) large developmental power reactors and associated electric generating facilities "near but not in" commercial and industrial centers has been brought forcefully to the attention of Congress and has resulted in no corrective legislation in spite of frequent and pertinent amendment of the Act. The very study made by the Commission in 1957 which was referred to by the court below was considered in detail by the Joint Committee on Atomic Energy in 1957, when it recommended and Congress enacted amendments to the Act which provided governmental indemnity for liability of licensees and contractors arising out of reactor accidents and which added certain procedural safeguards to the Act's licensing provisions. Congress did not include in such amendments any limitation on the Commission's authority with respect to reactor location, although the suggestion was made by a dissenting member of the Joint Committee that remote location should be required. See pp. 62-66, below.

C. Finally, this aspect of the decision of the court below ignores a definitive finding by the Commission of reasonable assurance that the proposed site is suitable for a reactor of the proposed size and type (R. 710-11). This finding, like the Commission's other findings on site and safety, is not attacked as unsupported by the evidence. The necessary effect of the decision below is thus to substitute the judgment of the court for that of the Commission with respect to matters that were not only plainly entrusted to the Commission's expert discretion by Congress

but that fall in the highly technical field of nuclear technology in which the Commission's special knowledge, experience and understanding are of particular importance.

ARGUMENT

I

THE COMMISSION'S FINDINGS OF REASONABLE ASSURANCE THAT A REACTOR OF THE GENERAL TYPE PROPOSED CAN BE SAFELY OPERATED AT THE PROPOSED SITE WERE SUFFICIENT TO SUPPORT ISSUANCE OF A PROVISIONAL CONSTRUCTION PERMIT UNDER THE STATUTE AND REGULATIONS

A majority of the court below held unequivocally that under the statute the Commission cannot issue a construction permit for a power reactor unless *at that time* it makes the same definitive findings with respect to safety of the proposed reactor that admittedly must be made prior to issuance of an operating license. The court quoted the contention of the respondents that

> "The Act and the regulations of the Commission . . . require, as conditions precedent to the issuance of every construction permit for an atomic energy power reactor, that *as of the time the construction permit is issued* the Commission find that (1) it has reasonable assurance that the reactor may be constructed *and operated* at the proposed site without undue risk to the health and safety of the public. . . ." (R. 957) (italics in original).

The court then added:

> "It is undisputed that the Commission must make such a finding when it authorizes operation. The question is whether it must make such a finding when it authorizes construction. *In our opinion it must*" (*ibid.*) (italics supplied).

It is thus plain that, although the court neither discussed nor cited Section 50.35 of the Commission's regulations,

the inevitable effect of its decision is to invalidate this regulation, the step-by-step licensing procedure which it provides, and the Commission's settled practice of issuing construction permits for developmental power reactors thereunder "on a provisional basis."

It is believed that a consideration of the relevant statutory provisions and their setting will make clear that this conclusion of the court below is erroneous, and that the Commission's regulation and action thereunder are in full accord with the provisions of the Atomic Energy Act. The decision below is based in large part upon a misunderstanding or disregard of the basic Congressional purpose to give broad effect to the Commission's expert evaluation of the many complex technical factors which must be considered in effectuating rapid and safe progress in the design, construction, testing and operation of developmental power reactors at this early stage of the application of atomic energy for peaceful uses.

A. TO EFFECTUATE ITS PURPOSE OF ENCOURAGING WIDESPREAD PARTICIPATION IN THE DEVELOPMENT AND USE OF ATOMIC ENERGY FOR PEACEFUL PURPOSES, THE ACT PRESCRIBES PRIORITY FOR ADVANCED DEVELOPMENTAL REACTOR PROJECTS AND GIVES THE COMMISSION BROAD AUTHORITY TO IMPLEMENT ITS GENERAL LICENSING PROVISIONS.

The Atomic Energy Act of 1954 is one of the landmark statutes of the postwar period. One need only turn to the Act's introductory section to see that the basic impulse behind it was an attempt to strengthen national security and improve the general welfare by encouraging and expediting the "widespread participation" of private industry in developing atomic power (Sections 1, 3, Appendix, p. 70). Reference to the statute's extensive legislative history[17] confirms the existence of broad Congressional recognition of the urgent need to accelerate

[17] This legislative history has been organized and published in three volumes, of 3994 pages. See U.S. Atomic Energy Commission, *Legislative History of the Atomic Energy Act of 1954* (GPO, 1955). For convenience it is hereafter cited as *Legis. Hist.*, and is included with citation of original sources.

the development of nuclear energy for peaceful purposes by allowing others in addition to the Federal Government to enter the field. Members of the Joint Committee on Atomic Energy acknowledged repeatedly that the United States was engaged in a crucial race for supremacy in peacetime atomic progress and that early exploitation of the ingenuity and inventiveness of private enterprise was essential. Congress acted on an impressive body of evidence that demonstrated the desirability of private industrial development of many different kinds of nuclear reactors, to be located in various parts of the United States, and that emphasized the importance of speed in such development in order to maintain American leadership in this field.[18]

In the substantive licensing provisions of the Act, Congress distinguished between commercial projects (Section 103) and research and development projects (Section 104) (Appendix, pp. 71-73, below).[19] More specifically, the Act contains a mandate to the Commission to refrain from imposing unnecessarily restrictive regulations

[18] See, *e.g., Hearings Before the Joint Committee on Atomic Energy on S. 3323 and H.R. 8862, to Amend the Atomic Energy Act of 1946*, 83d Cong., 2d Sess. (1954), pp. 197-98, 570, 582, II *Legis. Hist.* 1831-32, 2208, 2220; 100 *Cong. Rec.* 11661, 11973, 14870, III *Legis. Hist.* 2879, 3004, 3723; statement of Dr. Lawrence R. Hafstad, Director of Reactor Division, *Hearings Before the Joint Committee on Atomic Energy on Atomic Power Development and Private Enterprise*, 83d Cong., 1st Sess. (1953), pp. 22-23.

See also provisions of the Atomic Energy Act of 1954 contained in Sections 1, 3 a, d, and 104 b, Appendix, pp. 70, 72-73, below.

[19] Section 103, entitled "Commercial Licenses," requires a number of additional findings by the Commission. As a further prerequisite to the issuance of a *commercial* license, Section 102 requires the Commission to make a finding that the type of facility "has been sufficiently developed to be of practical value for industrial or commercial purposes" (Appendix, pp. 71-72, below). See also Section 105 c, which requires the Attorney General to advise the Commission whether a proposed commercial license "would tend to create or maintain a situation inconsistent with the antitrust laws." No commercial licenses under Section 103 have yet been issued by the Commission.

on developmental projects to be licensed (like the PRDC project) under Section 104. Section 104 b provides:

> "b. The Commission is authorized to issue licenses to persons applying therefor for utilization and production facilities [reactors] involved in the conduct of research and development activities leading to the demonstration of the practical value of such facilities for industrial or commercial purposes. *In issuing licenses under this subsection, the Commission shall impose the minimum amount of such regulations and terms of license as will permit the Commission to fulfill its obligations under this Act to promote the common defense and security and to protect the health and safety of the public* and will be compatible with the regulations and terms of license which would apply in the event that a commercial license were later to be issued pursuant to section 103 for that type of facility. In issuing such licenses, *priority shall be given to those activities which will, in the opinion of the Commission, lead to major advances in the application of atomic energy for industrial or commercial purposes*" (italics supplied) (Appendix, pp. 72-73).

In other words, Section 104 b enjoins the Commission not to impose in the way of research and development projects (such as that involved here) any administrative roadblocks that are not essential from the standpoint of security and safety, and it requires that priority be given to those activities most likely to lead to "major advances" in the industrial application of nuclear energy. The utmost encouragement is thus to be given to those developmental projects which give promise of pointing the way to major advances, as distinguished from those involving smaller steps forward. The Commission here found that the proposed PRDC project is one which qualifies for such encouragement (Findings 5, 10, 26, R. 702, 704, 709).

Section 182 a of the Act (Appendix, pp. 76-77) particularizes the nature of the Commission's obligations recited in Section 104 b "to protect the health and safety of the public" by providing specifically that in connection with

applications for "licenses to operate production or utilization facilities" [reactors] the applicant shall state such technical specifications and other information as the Commission's regulations shall require to enable it to find that such operation "will be in accord with the common defense and security and will provide adequate protection to the health and safety of the public." In other words, this key statutory provision states in terms that it is in connection with the issuance of an *operating license* that the Commission is required to make its definitive determination of *operating safety*.[20]

Section 185 (Appendix, p. 78) is fully consistent with this concept. This section provides specifically for the issuance of construction permits to applicants for "licenses to construct or modify" production or utilization facilities, "if the application is otherwise acceptable to the Commission." It further provides that upon completion of the construction of the facility, "upon the filing of any additional information needed to bring the original application up to date," upon a finding that the facility has been constructed "and will operate" in conformity with the application "as amended" and with the Act and the Commission's rules and regulations, and "in the absence of any good cause" shown to the contrary, the Commission shall issue an operating license to the applicant. Again, this section in

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[20] This language is highlighted by that used elsewhere in Section 182 a and in Sections 182 b, c, and d, where reference is made not to licenses "to operate" but merely to licenses generally, or licenses for a "facility." The latter usages plainly include a construction permit (as the last sentence of Section 185 expressly provides), while the former in terms excludes such meaning. See full text of these provisions in Appendix, pp. 76-77.

See also Section 104 d (Appendix, p. 73), providing that no "license" may be issued to any person under Section 104 "if, in the opinion of the Commission, the issuance of a license to such person would be inimical to the common defense and security or to the health and safety of the public". The Commission expressly found here that issuance of this provisional construction permit "will not be inimical to the common defense and security or to the health and safety of the public" (Finding 35, R. 711).

terms recognizes that an initial application need not and in many instances cannot contain all of the information required to be evaluated at the time the operating license is issued.

Finally, in addition to the directive contained in Section 182 a (above) to implement the statutory licensing provisions by rules and regulations, Section 161 i (3) further authorizes the Commission to "prescribe such regulations or orders as it may deem necessary . . . to govern any activity authorized pursuant to this Act, including standards and restrictions governing the design, location, and operation of facilities used in the conduct of such activity, in order to protect health and to minimize danger to life or property." See also Section 161 b, p (Appendix, p. 74).

These provisions, then, constitute the statutory framework on which the Commission was required to erect its regulatory structure. None of them specifies that the Commission must make its definitive reactor safety finding at the construction permit stage of the proceedings.

B. THE COMMISSION'S PROVISIONAL CONSTRUCTION PERMIT REGULATIONS ARE CONSISTENT WITH APPLICABLE STATUTORY PROVISIONS AND RESULT FROM THE NECESSARY ACCOMMODATION OF NUCLEAR TECHNOLOGY TO THE BASIC OBJECTIVES OF THE ACT

In preparing its regulations under these new statutory provisions, the Commission was thus faced with the very practical problem of determining what showing is to be required at the construction permit stage, having in mind especially the problems necessarily presented by developmental projects to which Congress directed it to give priority. The construction of such a large power reactor and associated generating facilities necessarily takes about four or five years. Yet the entire history to date of the peaceful application of nuclear energy comprises a span of only a little over a decade, and certainly for the next few years relatively brief periods undoubtedly will continue to witness vast accretions of knowledge in this field. The Commission with its detailed familiarity with the

course of technological progress in atomic energy, was plainly aware of the fact, which it specifically found in this case, that

> "it is in the nature of reactor design, although certainly not unique to it, that many features remain to be designed and demonstrated after construction is begun and indeed some features redesigned and replaced after operation is under way . . ." (R. 676).

The Commission also quoted approvingly (*ibid.*) the uncontradicted testimony of the late Dr. Mark Mills, a member of the Advisory Committee on Reactor Safeguards, that "practically all advanced technological developments take place with a sort of combined construction and research and development and necessary dovetailing of these things . . ." (R. 73-74), and of Dr. Hans Bethe that "the simultaneous pursuit of programs of research, development and construction has become standard in the fast-moving field of atomic energy and is necessary in order to keep abreast or ahead of our competitors" (R. 739). More specifically with respect to the area involved here it found that "technology regarding fast breeder nuclear reactors is a rapidly advancing art, and utilization and production facilities that will permit the most complete use of fuel for atomic energy offer a substantial advancement in this field" (Finding 5, R. 702).[21]

The Commission has thus understood fully from the outset that an advanced developmental reactor as contemplated by Section 104 b is by its nature a step beyond pre-

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[21] With respect to this particular reactor, the Commission further stated that

> "As in the case of any other power reactor at this stage of the art, in addition to the design features of the reactor which will be determined and demonstrated before the actual construction of the reactor, many other such features will be determined and demonstrated during its actual construction. This fact nicely underlines the importance of the development of the fast breeder reactor at an early date" (R. 668-69).

viously constructed and operated facilities. Continuing design modification based on experience obtained as construction progresses is unavoidable for this type of project. Furthermore, in view of the potential consequences of a release of fission products to the environment, the very high degree of assurance of safety of operation which must be shown for any large reactor before such operation is permitted itself makes it impracticable for the Commission to reach this definitive decision with respect to such a developmental reactor on the basis of blueprints alone. This determination inevitably requires at the minimum the expert analysis and evaluation not only of the practical experience and associated research and experimental data gained in the course of construction, but also of the results of the extraordinarily rigid analysis, inspection and testing to which all of the numerous systems of such a reactor must be subjected after installation and prior to issuance of any operating permission.

It was readily apparent to the Commission, therefore, that to require a definitive safety finding with respect to operation of all reactors at the construction permit stage would render it essentially impossible ever to allow non-Governmental bodies to construct developmental reactors which would, in the words of the statute, "lead to major advances in the application of atomic energy for industrial or commercial purposes." At best it would considerably delay private development in this field. Either result would be contrary to the stated Congressional policy to foster private developmental programs with the greatest practicable expedition.

On the other hand, the Commission was understandably concerned that, in the absence of a preliminary showing with respect to probable safety of operation, ill-considered projects, having no substantial chance of successful completion or eventual licensing, might be encouraged with resultant economic waste. Acting pursuant to the authority granted by Congress, the Commission accordingly promulgated Section 50.35 of its regulations as a sensible and practicable solution to this problem. The step-by-step procedure which it contemplates was designed to accommodate

the technological facts of life, with which the Commission was fully acquainted, to the Congressional mandate.

Although we have summarized Section 50.35 of the Commission's regulations above, its substance bears repeating. This regulation provides that, in cases where the nature of a project is such that it is not practicable to submit initially all the technical information needed to complete the application for license, a construction permit may be issued "on a provisional basis," if the applicant can show "reasonable assurance" that a reactor "of the general type proposed" can be operated at the proposed site "without undue risk to the health and safety of the public," and that "the omitted information will be supplied." It further provides that this provisional permit shall be expressly subject to a later determination by the Commission that "the final design provides reasonable assurance that the health and safety of the public will not be endangered."

This regulatory scheme is perfectly consistent with the controlling provisions of Sections 182 and 185 of the Act. As stated above (pp. 28-29), Section 182 a makes reference to the key finding that the "utilization . . . of special nuclear material [reactor operation] will . . . provide adequate protection to the health and safety of the public" only in connection with "applications for licenses *to operate* production or utilization facilities" (italics supplied). The last clause of Section 50.35 of the regulations in terms so provides.

Similarly, Section 185 of the Act calls for the issuance of construction permits on applications "for licenses to construct or modify" reactors if, in the most general terms, "the application is otherwise acceptable to the Commission." This section plainly contemplates that during the course of construction there will probably have to be submitted "additional information needed to bring the original application up to date," and specifically provides further that an operating license is to be issued only when the reactor has been completed and findings have been made that it will operate (i) in conformity with the application "as amended," (ii) in conformity with the

Act and the Commission's regulations (including, of course, the specific requirement in Section 182 a that the Commission find that such operation "will provide adequate protection to the health and safety of the public"), and (iii) "in the absence of any good cause being shown to the Commission why the granting of an operating license would not be in accordance with" the statute. These provisions on their face call for rather than forbid the type of regulatory structure erected on them by the Commission in Section 50.35 of its regulations.

C. THE COMMISSION'S FINDINGS HERE SATISFIED THE STATUTE AND REGULATIONS AND WERE NOT AMBIGUOUS

As stated heretofore, the Commission made the precise findings called for by Section 50.35 of its regulations. Finding 22 states (R. 708):

> "The Commission finds reasonable assurance in the record, for the purposes of this provisional construction permit, that a utilization facility of the general type proposed in the PRDC Application and amendments thereto can be constructed and operated at the location without undue risk to the health and safety of the public."

The Commission also found that "there is no inherent hazard or danger to the health and safety of the public in the construction or operation of fast breeder reactors" (Finding 5, R. 702-03), and that issuance of this provisional construction permit "will not be inimical to the common defense and security or to the health and safety of the public" (Finding 25, R. 711), as required by Section 104 d (Appendix, p. 73).

In a further statement in its opinion, to be taken as a finding of fact (R. 700), the Commission said (R. 665):

> "The principal factual issue in this proceeding is whether there is information sufficient to provide a reasonable assurance that a utilization facility of the general type proposed in the PRDC application can be constructed and operated at the location proposed therein without undue risk to the health and safety

of the public. Subsidiary to this issue is whether there is reasonable assurance that technical information omitted from, and required to complete, the application will be supplied before issuance of an operating license. *A careful evaluation of the entire record in this proceeding can only lead to an affirmative answer to all of these questions*" (italics supplied). See also Finding 33, R. 711.

These findings were held by the court below to be insufficient to satisfy the statutory requirements. The court's conclusion was based on the fact that the findings were stated to have been made for the purposes of the only matter then before the Commission, *i.e.*, "for the purposes of this provisional construction permit,"[22] and from the fact that the Commission stated in its opinion that "the degree of 'reasonable assurance' with respect to safety

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[22] The majority opinion below attached considerable significance to the fact that in its Initial Decision of December 10, 1958, the Commission's Finding 22 (R. 615) did not include the phrase "for the purposes of this provisional construction permit" (R. 960-61). A comparison of the Initial (R. 918-38, 607-29) and Final (R. 630-712) Decisions as a whole, however, will make it clear that the Commission intended no change of substance by the inclusion of this phrase. In its Initial Decision it plainly stated that "the degree of certitude that satisfies us for purposes of the provisional construction permit would not be the same as we would require if we were at this moment considering the issuance of the operating license. 'Reasonable assurance' can be a different standard for the one purpose from what it is for the other" (R. 934). Compare AEC Opinion and Final Decision, R. 679. The Commission's reason for stating in its Final Decision that its findings were for purposes of the provisional construction permit was only to reemphasize and to make particularly explicit, in the light of the exceptions to the Initial Decision which had been filed by respondents (R. 939-45), that the finding made was not the one which would be required to support an operating license, and was not to be taken as any indication that such a license would be issued as a matter of course. In summarizing the purport of its Final Decision the Commission stated: "we amplify and affirm our Opinion and Initial Decision dated December 10, 1958" (R. 631).

that satisfies us in this case for purposes of the *provisional* construction permit would not be the same as we would require in considering the issuance of the *operating* license" (R. 679). The essence of the court's reasoning is that the statute does not permit differing degrees of "reasonable assurance" to be applied by the Commission for provisional construction permits on the one hand and for operating licenses on the other.

This interpretation destroys the regulatory scheme based upon Section 50.35 of the Commission's regulations. The plainly stated purpose of this section is to permit construction to begin in appropriate cases where all the information needed for the final safety verification of the particular reactor is not initially available but where it can be shown that data to provide such proof can probably be obtained during the necessarily extended construction period. This purpose is effectuated by the requirement of an initial showing of "reasonable assurance" of safe operation not of the precise design projected but of a reactor "of the general type proposed." This careful phraseology recognizes the technological fact that, at this stage of development of the art, substantial design changes will in many cases be required during the course of construction, such changes to be within the concept of "the general type proposed." See AEC Opinion, R. 668-69, quoted *supra*, p. 31, footnote 21.

The use of this language in the regulation also emphasizes the basic philosophy underlying it, that the degree of certainty required to support a provisional construction permit is necessarily less than that required for purposes of an operating license. At the provisional construction permit stage the Commission is dealing, as the words of its regulation recognize, not with a definitively designed machine, but rather with a design concept ("general type proposed"), to be perfected into a "final design" as the combined construction and research and development program progresses. The "reasonable assurance" with respect to operation which can be shown for such a design concept is inherently of a different order than that which can and must later be shown for the reactor as

finally built and tested.[23] The "reasonable assurance" required for a provisional construction permit thus embodies to a substantial degree the concept of probability that the conditions imposed can be met, *i.e.*, that "the omitted information will be supplied" and that it can later be shown that "the final design provides reasonable assurance that the health and safety of the public will not be endangered." This is the crux of the Commission's regulatory scheme, and it is this scheme which the court below held to be beyond the Commission's statutory authority to erect.

The court's further determination that the Commission's findings were "ambiguous" (R. 963) stems from the mistaken premise that a definitive finding of safety of the reactor as initially designed is required for issuance of a provisional construction permit. On this premise, the court thought that some of the Commission's findings could be read as meeting this test but that others did not; in this respect only the court considered the findings to be ambiguous. A careful consideration of these findings in the light of the provisional construction permit regulation and of the full and plain explanation given in the Commission's opinion, however, makes it clear that none of the findings was intended to be a definitive determination with respect to this precise reactor design. The findings are not, therefore, ambiguous at all but are those contemplated by Section 50.35 of the regulations.

D. NOTHING IN THE LEGISLATIVE HISTORY INDICATES A PURPOSE TO DEPRIVE THE COMMISSION OF AUTHORITY TO ISSUE CONSTRUCTION PERMITS ON A PROVISIONAL BASIS

The court below relied heavily on an isolated passage from the legislative history of this complex statute (R. 958-60) to reach a conclusion contrary to the import of

[23] It is well recognized that the same word or phrase used in statutes or regulations may have quite different meanings, depending upon the context. Compare *Lee* v. *Madigan*, 358 U.S. 228, 230-31. "Reasonable assurance" may properly mean such degree of certainty, persuasion or confidence as may be expected or required under the particular circumstances, and the Commission here so interpreted these words as used in its regulation (R. 679-80).

the statutory language. This consists of a brief exchange on the floor of the Senate between Senators Humphrey and Hickenlooper, during the extensive debate on the bill (100 *Cong. Rec.* 12014, III *Legis. Hist.* 3759-60). Before turning to this colloquy, however, it is important to call attention to the setting in which it occurred—a setting apparently not considered at all by the court below.

The Atomic Energy Act of 1954 was adopted after one of the most heated and extensive debates in recent Congressional history. There was little discussion of questions such as safety criteria and procedures which were necessarily dependent upon substantial technical understanding. The core of the legislative fight was with respect to the impact of the bill on Federal electric power policy. The late Herbert S. Marks, one of the most knowledgeable scholars in this relatively new field, summarized quite well the nature of these debates and the Congressional approach taken to the issues involved in a study published shortly after enactment of the Act:

> "The story of the fight over power in the enactment of the new law is a complex one. Long experience made members of Congress familiar with the intricacies of this field, whereas neither they (nor most of us) have ever felt confident about the mysteries of nuclear fission. Congressmen made the most of their experience.
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> "The seesaw fight on power policy is reflected in variations in successive drafts of bills before the Joint Committee, in amendments on the House and Senate floors and in further changes in the lengthy conference between the two bodies. The final compromises were not worked out until late August 1954 after debate which approached a filibuster. In dealing with power policy the new law bears traditional marks of debate and compromise—in contrast to the treatment of most other matters which were settled in Committee before

any bill was reported out and were adopted by the Congress without material change." [24]

Senator Humphrey, although not a member of the Joint Committee on Atomic Energy, was one of the most active participants in these debates in the Senate; he opposed the administration bill throughout, and voted against its passage (100 *Cong. Rec.* 12242, III *Legis. Hist.* 3877). As the debates were drawing to a close, he called up an amendment he had offered to the construction permit provisions of the bill (Section 185) which would have added at the end of that section the clause, "and no construction permits shall be issued by the Commission until after the completion of the procedures established by Section 182 for the consideration of applications for licenses under this act." (100 *Cong. Rec.* 12014, III *Legis. Hist.* 3759). This amendment was withdrawn when Senator Hickenlooper explained that it had been rendered unnecessary by an amendment made to Section 189 explicitly making construction permits as well as operating licenses subject to hearings and related administrative procedures (see p. 43, n. 26, below). Because of the great reliance placed on it by the court below, the exchange in its entirety is quoted in the margin (100 *Cong. Rec.* 12014, III *Legis. Hist.* 3759-60): [25]

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[24] Marks and Trowbridge, *Framework for Atomic Industry, A Commentary on the Atomic Energy Act of 1954* (B.N.A. 1955), p. 38. Throughout consideration of the bill, there was also extensive controversy over the need or desirability of amending the 1946 Act at all to permit private ownership of atomic reactors, those opposing this change urging that atomic energy should continue to be developed exclusively under the auspices of the Federal Government. See, *e.g.*, testimony on behalf of the Congress of Industrial Organizations, in *Hearings Before the Joint Committee on Atomic Energy on S. 3323 and H.R. 8862, to Amend the Atomic Energy Act of 1946*, 83d Cong., 2d Sess. (1954) pp. 486-515, II *Legis. Hist.* 2120-49.

[25] "Mr. HUMPHREY. Mr. President, at the time I drew up this amendment I was not aware of the modifications which had been made to section 182 and also to the judicial review section, which

Taken at face value, out of the context of the debate as a whole, this colloquy could be read as indicating an intention on the part of Senator Humphrey, at least, to require the definitive safety determination for all reactors to be made at the construction permit rather than at the operating license stage of the proceedings. When considered in the setting in which it occurred, however, it is believed plain that neither of the parties to the exchange had in mind any such broad limitation or objective, and that neither so interpreted the statutory provisions under discussion. In fact, they were not discussing or considering the question of when or on what basis reactor safety determinations should be made. The area being debated was quite remote from this important but technologically complex question.

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later I discussed with the chairman of the committee. The purpose of the amendment when it was prepared was to make sure that the construction of a facility was not permitted prior to the authorization of a license, because had that been done what it would have amounted to would be getting an investment of a substantial amount of capital, which surely would have been prejudicial in terms of the Commission issuing the license. In other words, if the Commission had granted the construction permit for some form of nuclear reactor, and then the question of a license was not fully resolved, surely there would have been considerable pressure, and justifiably so, for the Commission to have authorized the license once it had authorized the permit for construction.

"The chairman of the committee tells me he has modified certain sections by the committee amendments to the bill, of which at that time I was not aware. The chairman indicates to me that under the terms of the bill, as amended, the construction permit is equivalent to a license. In other words, as I understand, under the bill a construction permit cannot be interpreted in any other way than being equal to or a part of the licensing procedure. Is that correct?

"Mr. HICKENLOOPER. The Senator is correct. The staff has worked on this matter. An amendment was offered on, I believe, July 16, to section 189, having to do with hearings or judicial review, and that section was tied up with other sections of the bill. A license

Senator Humphrey's amendment had been first advocated by Representatives Holifield and Price (who also opposed and voted against the bill, 100 *Cong. Rec.* 12024-25, III *Legis. Hist.* 2962-63) in their separate views attached to the Joint Committee's report on the bill (H. R. Rep. No. 2181, 83d Cong., 2d Sess. (1954), pp. 105-38, I *Legis. Hist.* 1101-34). Under the heading "Inadequate power licensing provisions", they suggested a number of amendments to provide what they considered to be "safeguards to protect the public interest in the licensing of non-Federal agencies to produce and sell atomic power" (*id.* at 120, I *Legis. Hist.* 1116). That these amendments were concerned with Federal electric power policy rather than public safety is indicated

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and a construction permit are equivalent. They are the same thing, and one cannot operate until the other is granted.

"The same is true with reference to hearings. Therefore, we believe, and we assure the Senator, that the amendment is not essential to the problem which he is attempting to reach.

"Mr. HUMPHREY. Let me ask the chairman of the committee if subsection b of section 182, which applies to license applications, also applies to construction permits. Subsection b reads:

> "b. The Commission shall not issue any license for a utilization or production facility for the generation of commercial power under section 103, until it has given notice in writing to such regulatory agency as may have jurisdiction over the rates and services of the proposed activity, and until it has published notice of such application once each week for 4 consecutive weeks in the Federal Register, and until 4 weeks after the last notice.

"Mr. HICKENLOOPER. The section does. The answer to the Senator's question is 'Yes.'

"Mr. HUMPHREY. In other words, the revised sections on judicial review and on hearings and the revised section 182 on license application all apply directly to construction permits?

"Mr. HICKENLOOPER. Yes.

"Mr. HUMPHREY. With that statement, Mr. President, I withdraw my amendment. The only purpose of the amendment was to clarify that section. I am grateful to the chairman for having done it before the amendment was considered."

further by their statement that the bill's licensing provisions were lacking in adequate safeguards "except fo. the requirements of national security and public health and safety" (*id.* at 121, I *Legis. Hist.* 1117).

The only provisions of Section 182 of the bill which Representatives Holifield and Price proposed to amend were subsections b and c (redesignated in the Act as amended as subsections 182 c and d, respectively, Appendix, p. 77). These dealt with commercial license applications under Section 103, and provided for notice to regulatory agencies and for preference to those facilities located in high power-cost areas. It was urged that subsection b be broadened to require notice "to public and cooperative electric systems within transmission distance", and to provide for opportunity for intervention, hearing, and appeal in cases of protests or conflicting applications. It was similarly suggested that subsection c be amended to provide for preferred consideration "to public bodies where their applications conflict with those of privately owned systems" (*id.* at 122, I *Legis. Hist.* 1118).

Immediately following these proposals, Representatives Holifield and Price recommended the amendment to Section 185 which was later introduced and withdrawn by Senator Humphrey (p. 39, above), explaining that it was needed in order to make construction permits "specifically subject to the same procedural safeguards, assuring interested parties full opportunity for notice, hearing, and appeal before issuance, as are provided in connection with the issuance of licenses under Section 182". When read in conjunction with their then proposed amendments to subsections 182 b and c of the bill, including the provisions for intervention and hearings on conflicting commercial license applications proposed to be included in subsection b, it is plain that the purpose of this change in Section 185 was to implement these provisions as they were proposed to be amended.

On July 16, 1954, during the extended Senate debates, Senator Hickenlooper introduced and the Senate adopted an amendment to Section 189 of the bill to incorporate therein the specific provisions for intervention and hearings

on both construction permit and operating license applications which are now contained in the first sentence of Section 189 a of the Act (Appendix, p. 78).[26] On the same day Senator Humphrey introduced the three amendments mentioned above which had been suggested by Representatives Holifield and Price to broaden subsections 182 b and c of the bill, and to make their procedures specifically applicable to construction permits (pp. 41-42, above) (I *Legis. Hist.* 1165-66 [§ 182 b], *id.* at 1174 [§ 182 c], *id.* at 1168 [§ 185]). That portion of the two amendments broadening the notice and preference provisions of these two subsections specifically to include public and cooperative bodies was adopted when called up on July 22 (100 *Cong. Rec.* 11404, 11420, III *Legis. Hist.* 3475, 3479), but the provisions of the amendment to include intervention, hearing and review procedures in Section 182 b were withdrawn by Senator Humphrey on the ground that these matters were already covered by Senator Hickenlooper's hearing and judicial review amendments to Section 189 which had been previously adopted (100 *Cong. Rec.* 11404, III *Legis. Hist.* 3475).

Four days later, on July 26, 1954, Senator Humphrey called up and then withdrew the third of the three related amendments, making "completion of the procedures established by Section 182" a prerequisite to issuance of construction permits. He described his purpose in doing this as "primarily to clear the legislative history in reference to the bill" (100 *Cong. Rec.* 12014, III *Legis. Hist.* 3759). The withdrawal of the amendment was based on Senator Hickenlooper's explanation that the changes which had

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[26] 100 *Cong. Rec.* 10685-86, III *Legis. Hist.* 3174-75; Amendment, July 14, 1954, I *Legis. Hist.* 1145-46. Senator Hickenlooper explained that his amendment "reincorporates the provisions for hearings formerly made part of Section 181 but clearly specifies the types of Commission activities in which a hearing is to be required. The purpose of this revision is to specify clearly the circumstances in which hearings are to be held. This section also reincorporates the former provisions of Section 189 dealing with judicial review" (*ibid.*).

been effected in Section 189 making construction permits expressly subject to the hearing and related procedural provisions rendered such amendment unnecessary. While the "procedures" referred to in his proposed amendment had thus been taken care of, Senator Humphrey apparently wanted also to make sure that the notice and preference provisions of subsections 182 b and c which had been broadened by his other related amendments still applied to construction permits, and this was his objective in questioning Senator Hickenlooper (quoted in footnote 25, pp. 39-41, *supra*).

It was obviously in this context that he referred to the possibility of "pressure" to obtain an operating license which might be exerted by the holder of a construction permit. The several related amendments to Section 182 with which Senator Humphrey had been concerned dealt only with *commercial* licenses under Section 103 and were concerned primarily with the situation presented by competing applications for such licenses. It is in this area, where an applicant could genuinely be misled into making a commercial investment in reliance on a construction permit, that he might "justifiably" (as Senator Humphrey put it) bring pressure on the Commission to issue an operating license, to the detriment of a competing applicant if the latter's claim had not been considered at the construction permit stage. Compare *Community Broadcasting Co.* v. *Federal Communications Commission*, 274 F.2d 753 (App. D.C. 1960).[27]

[27] Because of a possible shortage of available special nuclear material, competing applications for licenses to use such material were considered very real possibilities, and the public power preference provision was thus thought to be of considerable practical importance. See Senator Humphrey's remarks on this at 100 *Cong. Rec.* 11420, III *Legis. Hist.* 3479; compare Section 53 of the Act, providing for priority allocation to basic research "in the event that applications for special nuclear material exceed the amount available for distribution" (Appendix, pp. 70-71). In fact, no shortage of nuclear fuel and no competing applications have yet developed.

On July 23 1954, three days before the colloquy between Senators Humphrey and Hickenlooper, Senator Jackson had expressed gen-

In this context, Senator Hickenlooper readily agreed that "a license and construction permit are equivalent" (100 *Cong. Rec.* 12014, III *Legis. Hist.* 3759). He obviously meant that they were equivalent from the standpoint of the procedural safeguards provided in his amendment to Section 189 and of the notice and preference provisions which had been in controversy. That no more than this was intended by even Senator Humphrey is indicated by his subsequent reference to this colloquy in a statement included at his request in the Congressional Record just prior to the vote on the bill in the Senate. In this statement he described the interpretation discussed on the floor and principally relied on by the court below as "applying same preference standards to construction permits as provided by previous amendment for licenses to use atomic energy" (100 *Cong. Rec.* 12242, III *Legis. Hist.* 3877). In thus describing the objective accomplished by his exchange with Senator Hickenlooper, Senator Humphrey indicated again that even the minority did not have in mind the far-reaching limitation on the Commission's authority which the court below has now imposed.[28]

erally similar arguments in favor of this same amendment to Section 185, making it even clearer that he considered that the amendment was needed to prevent circumvention of "the carefully devised provisions of the bill relating to issuance of licenses" (100 *Cong. Rec.* 11560, III *Legis. Hist.* 3528). The provisions to which he referred in terms (100 *Cong. Rec.* 11558-60, III *Legis. Hist.* 3526-28) were the "safeguards" outlined by Representatives Holifield and Price in their separate statement and described above at pp. 41-42.

[28] The progress of the legislation in the House verifies this conclusion. At the outset of the debate, Representative Holifield stated that he would later offer 33 amendments including four (Nos. 29-31, 33) to Sections 182 and 185 of the bill (100 *Cong. Rec.* 10956-58, III *Legis. Hist.* 2846-48; see H. R. 9757, S. 3690, 83d Cong., 2d Sess. (1954), I *Legis. Hist.* 625-29, 729-33). These four covered the same ground as the three amendments introduced by Senator Humphrey in the Senate (I *Legis. Hist.* 1165-66, 1168, 1174) and required (1) notice of commercial license applications to be given to public bodies and cooperatives (§ 182 b); (2) intervention and hearings in cases of conflicting or protested commercial applications (§ 182 b); (3) preference for public and cooperative bodies in granting commercial

Examination of the specific statutory language enacted in Sections 182 and 189 confirms that Senators Humphrey and Hickenlooper were right that no amendment was needed to make either the revised hearing and judicial review provisions of Section 189, or those provisions of Section 182 which have reference only to "licenses" generally, applicable to construction permits. As pointed out above (pp. 28-29, 33) a distinction is drawn in Section 182 between the generic term "licenses" (which includes construction permits as stated in Section 185), and the more limited expression, "licenses to operate". The former term alone is used in the notice and preference subsections c and d (originally designated b and c) in which Senator Humphrey was interested, while the latter is the term used in connection with the Commission's safety determination called for in subsection a. Neither the amended Section 189 referred to by Senator Hickenlooper nor Senator Humphrey's withdrawn amendment to Section 185 can reasonably be read as intended to obliterate this distinction.

licenses (§ 182 c); and (4) "completion of the procedures established by section 182 . . ." before issuance of construction permits (§ 185). See 100 *Cong. Rec.* 10958, III *Legis. Hist.* 2848. When the licensing provisions of the bill came up for amendment in the House, Representative Cole (Chairman of the Joint Committee) first offered an amendment, identical to that earlier offered by Senator Hickenlooper in the Senate (pp. 42-43, above), expanding Section 189 so as to provide for hearings on licenses and construction permits as well as judicial review (100 *Cong. Rec.* 11747, III *Legis. Hist.* 2955). As in the Senate, this amendment passed without opposition. *Ibid.* The first and third of the Holifield amendments, concerning notice (§ 182 b) and preference for public bodies (§ 182 c) were offered immediately following passage of the Cole amendment (100 *Cong. Rec.* 11747-49, III *Legis. Hist.* 2955-57). Neither the proposal to amend Section 182 b to provide procedure for intervention and hearings nor that to amend Section 185 to make construction permits subject to the procedures which Section 182 would have contained had it been so amended were offered at this or any other time, however, for the obvious reason that the Cole amendment accomplished the objectives of these proposals.

In relying on this colloquy without reference either to its background or to the specific statutory language with which it was concerned, the court below has erroneously imposed on the Commission a serious restriction which was neither justified by the statutory provisions nor intended by the parties to the exchange.[29] Legislative history is most useful in revealing general purpose and not "the specific meaning of a statute on a particular occasion." Cox, *Judge Learned Hand and the Interpretation of Statutes*, 60 Harv. L. Rev. 370, 379 (1947). The exchange relied on is a good illustration of the wisdom of the proposition that "a loose statement even by a chairman of a committee, made impromptu in the heat of debate, less informing in cold type than when heard on the floor, will hardly be accorded the weight of an encyclical." Frankfurter, *Some Reflections on the Reading of Statutes*, 47 Colum. L. Rev. 527, 543 (1947).

The Commission rather than the court below has properly understood and applied the basic Congressional purpose as indicated both by the wording of the applicable statutory provisions and by the Act's over-all legislative history.[29]

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[29] The court below also relied on a statement contained in the Joint Committee Report on the bill that Section 185 "requires the issuance of a license if the construction is carried out in accordance with the terms of the construction permit." (Sen. Rep. No. 1699, H.R. Rep. No. 2181, 83d Cong., 2d Sess. (1954), p. 28, 1 *Legis. Hist.* 776, 1024). The "terms" of provisional construction permits such as the one involved here (R. 718), however, incorporate the condition required by the statute and by Section 50.35 of the regulations that, before an operating license is issued, there must be a showing that "the final design provides reasonable assurance that the health and safety of the public will not be endangered." The construction permit holder is thus on notice from the outset that this as well as any other term or condition imposed must be satisfied before an operating license can be issued. The Committee Report does not indicate an intent to deny to the Commission authority to issue construction permits on such terms and conditions.

E. THE COMMISSION'S CONTEMPORARY CONSTRUCTION AND CONSISTENT PRACTICE AND THE ACQUIESCENCE OF CONGRESS THEREIN ARE ENTITLED TO CONTROLLING WEIGHT

Even if this question of statutory interpretation could be considered to be not free from doubt, that doubt should be resolved in favor of the Commission's regulation and its consistent interpretation and application of the Act. The regulation involved here was promulgated pursuant to authority expressly delegated to the Commission in Sections 161 b, i, p, and 182 a, as an appropriate means of implementing the directive in Section 104 b "to protect the health and safety of the public" with a minimum of restriction and a maximum of expedition (Appendix, pp. 72-73). The licensing provisions of the Act could not themselves come into effect until the framework they provided was built upon by the Commission's regulations. Congress plainly intended to grant the Commission substantial discretion of a quasi-legislative nature in implementing and effectuating the Act's basic purposes. See 1 Davis, *Administrative Law Treatise* (1958), § 5.03, pp. 302-03; compare *Addison* v. *Holly Hill Fruit Products, Inc.*, 322 U.S. 607, 613-14; *American Trucking Associations, Inc.* v. *United States*, 344 U.S. 298, 314.

It is axiomatic that an agency's interpretation of the statute which it administers is entitled to great weight. As this Court aptly stated in *United States* v. *American Trucking Associations, Inc.*, 310 U.S. 534, 549, quoting with approval *Norwegian Nitrogen Co.* v. *United States*, 288 U.S. 294, 315:

> "This is peculiarly true here where the interpretations involve 'contemporaneous construction of a statute by the men charged with the responsibility of setting its machinery in motion, of making the parts work efficiently and smoothly while they are yet untried and new.'"

In this case these principles are even more applicable. Not only is the Commission operating in a wholly new

field involving a complex technology the very understanding of which requires knowledge and skill of a high order, but in a field in which until the enactment of this statute in 1954 the Federal Government, acting through this very Commission, had an absolute monopoly. See Marks and Trowbridge, *supra* note 24, at pp. 1-4. In accordance with the practice developed under the predecessor Atomic Energy Act of 1946, the Commission has to an unusual degree kept the Congress, through the Joint Committee on Atomic Energy, fully informed of its activities and practices under the Act. In fact, the extent of the contact with and supervision of the activities of the Commission by the Joint Committee on Atomic Energy has been unparalleled by that of any other Federal regulatory agency. Compare *Panama Canal Co. v. Grace Line, Inc.*, 356 U.S. 309, 318-19.[30]

The Commission's interpretation of the Act to permit construction permits on a provisional basis and its settled practice in issuing permits on this basis for developmental

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[30] The Joint Committee occupies a unique role in that it was established by the Atomic Energy Act of 1946, Section 15 (60 Stat. 772), and was continued with substantially similar powers by Sections 201-07 of the Atomic Energy Act of 1954. Section 202 of the 1954 Act continues the directive of Section 15(b) of the 1946 Act that "the Commission shall keep the Joint Committee fully and currently informed with respect to all the Commission's activities" (Appendix, p. 79). Numerous other sections of the Act provide specifically for supervision or approval by the Joint Committee of various types of Commission action. *E.g.*, determination of new special nuclear material (§ 51), or new source material (§ 61); determination of fair prices for special nuclear material (§ 58); approval of foreign cooperative agreements (§ 123 c, d); approval of electric utility contracts (§ 164); special report on occurrence of certain nuclear incidents (§ 170 i).

A further indication of the unusual degree of continuing attention given by Congress to this area is found in the fact that the Atomic Energy Act of 1954 has been amended in some particular at every session since its original enactment. P.L. 337 (1955); P.L. 722, 1006 (1956); P.L. 85-79, 85-256 (1957); P.L. 85-479, 85-602, 85-681, 85-744 (1958); P.L. 86-300, 86-373 (1959); P.L. 86-457 (1960).

power reactors has been repeatedly brought before the Joint Committee, beginning even before the promulgation in 1956 of Section 50.35 of the regulations.[31] In 1957, the Commission's practice in this regard was considered by the Joint Committee in connection with an intensive study of the desirability of amendments to the Act with respect to Governmental indemnity and reactor safety. See *Hearings Before the Joint Committee on Atomic Energy on Governmental Indemnity and Reactor Safety*, 85th Cong., 1st Sess. (1957), pp. 62-65. A special study conducted by the Joint Committee staff and printed for the Committee's use in this connection recited in detail the Commission's provisional construction permit practice and included relevant excerpts from the 1954 Act's legislative history (including Senator Humphrey's amendment and its withdrawal). See *A Study of AEC Procedures and Organization in the Licensing of Reactor Facilities* (Comm. Print, 1957) pp. 5-6, 11-13, 70-74. Largely on the basis of this material, the Joint Committee recommended and Congress adopted several amendments to the very licensing provisions here involved, including the addition of a new subsection b to Section 182 requiring an analysis and public report by the Advisory Committee on Reactor Safeguards prior to issuance of any Section 103 or 104 b construction permit or operating license, and an amendment to Section 189 a, requiring notice and a public hearing in each

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[31] See AEC Opinion, R. 651-58, for summary of extent to which the Commission's practice with respect to provisional construction permits was brought to the attention of the Joint Committee on Atomic Energy by testimony given at Committee hearings in 1956 and again in 1958. See also *Hearings Before the Joint Committee on Atomic Energy on Development, Growth and State of Atomic Energy Industry*, 84th Cong., 2d Sess. (1956), pp. 106, 132-33; *id. on Governmental Indemnity and Reactor Safety*, 85th Cong., 1st Sess. (1957), pp. 62-65; *id. on Development, Growth and State of Atomic Energy Industry*, 85th Cong., 2d Sess. (1958), pp. 112, 119-23; *id. on Operation of AEC Indemnity Act*, 85th Cong., 2d Sess. (1958), pp. 56-57; *id. on Development, Growth and State of the Atomic Energy Industry*, 86th Cong., 2d Sess. (1960), pp. 101-09.

such case (Appendix, p. 78). No amendment was recommended or adopted to require a change in the Commission's provisional construction permit practice. With respect to the amendments which were recommended, the Joint Committee report stated that they

> "were added to the indemnity bill since it was felt that the Congress should not only try to give financial protection to innocent members of the public who might suffer in the unexpected case of a runaway reactor, but that the Congress should also provide all possible statutory requirements for assuring that reactors should be as safe as possible" (Sen. Rep. No. 296, H. R. Rep. No. 435, 85th Cong., 1st Sess. (1957) pp. 11-12).

In so amending and in effect re-enacting these licensing provisions, Congress thus "considered in great detail the provisions of the earlier legislation as they had been applied by the [Commission]", and it may accordingly be inferred that it accepted and approved that administrative construction. Compare *National Labor Relations Board* v. *Gullett Gin Co.*, 340 U.S. 361, 366. The Joint Committee plainly did not consider that its detailed study of Commission procedures indicated it to be either necessary or desirable to require a change in the Commission's consistent practice of issuing construction permits on a provisional basis, subject to the submission of further technical information and a later evaluation that "the final design provides reasonable assurance that the health and safety of the public will not be endangered" (AEC Regs. § 50.35). Under the circumstances such Congressional acquiescence should be given great weight. *United States* v. *Bergh*, 352 U.S. 40, 46-47; *United States* v. *Shreveport Grain & Elevator Co.*, 287 U.S. 77, 84. Compare *Ivanhoe Irrigation District* v. *McCracken*, 357 U.S. 275, 292-94; *Brooks* v. *Dewar*, 313 U.S. 354, 361.

The justification given by the court below for ignoring the effect normally to be given to such administrative interpretation and consistent practice is found in its statement that "the possibilities of harm are so enormous that any

doubt as to what findings the Act requires . . . should be resolved on the side of safety". (R. 960). At this stage of the proceedings, however, public safety is not in fact involved at all; as the Commission found, issuance or continuation of this provisional construction permit "does not in any manner adversely affect the health and safety of the public" or that of respondents (R. 658-59, 967-68). This is so because there is necessarily interposed between such construction permit and any operation of the reactor—the only event which could conceivably present any public hazard—the necessity for a further proceeding, a new determination by the Commission on further evidence to be adduced in a public hearing, and a new order, all of which will be subject to further judicial review on the record then made.

The court below sought to bridge this gap in its reasoning by the stated assumption, contrary to another uncontested finding of the Commission, that "if enormous sums are invested without assurance that the reactor can be operated with reasonable safety, pressure to permit operation without adequate assurance will be great and may be irresistible" (R. 962). It would be hard to find a case, however, in which the record is clearer that pressure of the type feared cannot realistically be exerted. The Commission in its opinion dealt with this question most explicitly:

> ". . . PRDC has been on notice since before the first shovel of dirt was moved that its construction permit is *provisional* upon further demonstration of many technological and financial facts, including the complete safety of the reactor. . . . Since PRDC has recognized the developmental nature of the reactor it is building and since it has expressly waived any commitment for an operating license (if there exists any of the type that the Intervenors [respondents] contend is implied by the construction permit), the possibility that the Commission would be in any way bound cannot be visualized. It would be hard to imagine a case where an applicant would be less able to argue that he had been misled by previous favorable Commission

action. Under the circumstances of this case, moreover, and in view of the wording of the provisional construction permit, it is perfectly clear that PRDC is assuming a substantial financial risk with its eyes wide open, and that the generation of any pressure from such ingredients would be quite absurd".[32]

A developmental project such as this by its nature seeks not to return monetary profit on a capital investment but to push back the frontiers of knowledge. Everyone who undertakes such a project recognizes from the outset that the particular avenue of attack chosen may prove less successful than anticipated; yet if the attack is not made the answer may never be known. Research and development work (which in the nuclear field is traditionally and necessarily measured in millions of more) could not be undertaken on any other basis. As Judge Burger stated in his dissenting opinion below, pressure based on financial expenditure could have significance where the ultimate issue involves one of striking a fine balance between competing economic considerations; it is not credible, however, that members of the Atomic Energy Commission would disregard their responsibilities and oaths and would "permit an operation dangerous to the public because 40 or 50 million dollars is invested in brick, mortar and steel by

[32] R. 649-50. It should be emphasized again that this is not a commercial enterprise whose sponsors could unexpectedly find themselves in the position of having wasted a large capital investment in an unusable "white elephant". The nature of this project as a non-profit developmental undertaking is inherently such that, even in the unlikely event that for some reason operation of the plant must be seriously postponed or cannot be undertaken at all, the substantial practical engineering information and experience developed in its design, construction and non-nuclear testing would be of value from the research and development standpoint, and the data thus obtained would contribute substantially to later generations of reactors. This position of PRDC has been repeatedly stated on the record, and was accepted by the Commission. See AEC Opinion, R. 650, n. 31.

men who knew from the outset they were engaged in a scientific gamble" (R. 967).

Furthermore, at the present stage of development of the art, it appears likely that in the long run the rigid licensing rule enunciated below is not a solution of the regulatory problem "on the side of safety"; it may well give rise to more safety problems than it solves if the reactor development program which Congress sought to encourage is to go forward at all. As the Court of Appeals read the provisions of the statute, they would "require the issuance of a license when the permitted construction is carried out"; in fact, the court referred to this "requirement" as a strong indication that the Act meant to "require, as a condition to the issuance of a construction permit, a finding that the proposed facility can be operated without undue risk to the health and safety of the public" (R. 960). This issuance of an operating license as a relatively automatic sequel to a construction permit may well be a safe and appropriate procedure when power reactors have become sufficiently standardized to justify issuance of commercial licenses under Section 103.[38] In an area in which the technology is moving forward so rapidly, however, the feasibility as well as the wisdom from a safety standpoint of attempting to reach a decision on the basis of information available in 1961, for example, which will control issuance of an operating license for an advanced developmental project to be completed in 1965 or 1966, would appear very dubious. This is the very type of question which the Commission, with the necessary

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[38] With respect to some of the small research and training reactors already licensed, for example, which the Commission in its opinion said "have become virtually production line items" (R. 649), it has already been possible to issue construction permits which have not fallen within the terms of Section 50.35 of the regulations and which have accordingly been issued on the basis of findings of "reasonable assurance that *the reactor* can be constructed and operated at the proposed location without undue risk to the health and safety of the public" (italics supplied). See, *e.g.*, CPRR-50, *American Radiator and Standard Sanitary Corp.*, 25 Fed. Reg. 1968.

expertise available to it, is much better qualified to resolve than are the courts, and the type of question which Congress plainly intended to entrust to the Commission's informed judgment.

II

THE HOLDING THAT THE COMMISSION MAY NOT APPROVE ANY REACTOR SITE NEAR POPULATED CENTERS WITHOUT FINDING "COMPELLING REASONS" THEREFOR IS NOT REQUIRED BY ANY PROVISION OF THE ACT AND IS INCONSISTENT WITH EXPRESSED CONGRESSIONAL INTENT

As an alternative ground of decision, the court below held the Commission's findings to be "deficient in an additional respect" (R. 964). This deficiency was in failing to find "compelling reasons" for approving a site for the reactor located in a primarily rural area some thirty miles from the city of Detroit. The court said:

> "We think it clear from the Congressional concern for safety that Congress intended no reactor should, without compelling reasons, be located where it will expose so large a population to the possibility of a nuclear disaster. It does not appear that the Commission found compelling reasons or saw that such reasons were necessary" (R. 964).

Although the court purported to be construing the Atomic Energy Act of 1954, it cited no provision of the statute nor any item of its legislative history as requiring or even suggesting the necessity for such a finding; rather, it indicated that in its judgment the fact that a reactor so located could expose what it called "so large a population" to the mere *possibility* of nuclear disaster made this additional determination on the part of the Commission mandatory because of what it called the general "Congressional concern for safety." No such "compelling reasons" have been found to support approval of the location of any other reactor, whether constructed by the Commission itself or licensed to be constructed pri-

vately, nor has such finding heretofore been considered by the Commission to be either necessary or appropriate.

That the rule enunciated by the court below was intended as a practical matter to impose a substantive limitation on the Commission's power to approve the location of large reactors in any populated area is indicated by the further statement that

> "We need not consider whether even the most compelling reasons for preferring this location could support a finding that the reactor could be operated at this location without 'undue' risk, or with 'adequate' protection, to the health and safety of the public" (R. 965).

It is important to note that in this aspect of its decision the majority of the court below was referring in terms to "a typical large power reactor" and not to any unique characteristics of this particular project. The statements quoted with respect to potential maximum danger to the population in the general vicinity of a large reactor were taken from the Commission's letter of March 22, 1957, to the Joint Committee on Atomic Energy (R. 349, 353), forwarding a lengthy Commission study entitled, "Theoretical Possibilities and Consequences of Major Accidents in Large Nuclear Power Plants"—the so-called "Brookhaven Report" (R. 874-917). This is a detailed environmental analysis of general applicability to power reactors as such, and its conclusions are expressly subject to the numerous assumptions and limitations stated therein. Similarly, the statement quoted in the opinion that there is a "possibility of a major disaster, even though it has a low probability," is taken from testimony initially made to the Joint Committee on Atomic Energy by Dr. C. Rogers McCullough, former Chairman of the Commission's Advisory Committee on Reactor Safeguards, as part of his "general views on these questions of hazard evaluations" for reactors generally (R. 70-73; *Hearings Before Joint Committee on Atomic Energy on Governmental Indemnity for Private Licensees and AEC Contractors Against Reactor Hazards*, 84th Cong., 2d Sess. (1956), pp. 46-50).

In emphasizing only that part of the Brookhaven Report which dealt with the maximum damage that could theoretically result from a release of fission products from a large reactor, the court below ignored (or perhaps was unaware of) the related discussion in the report of both the multiple layers of containment and other available protective measures which could prevent this from happening, as well as the minuscule probability that damage of this order of magnitude could occur.[34] On the basis of a consideration of only half of the picture presented by the technical study relied on, and without reference to any specific statutory requirement, the court thus reached the overriding policy conclusion that, at least in the absence of some extraordinary justification, no power reactor may be approved by the Commission if located in an area of comparable population density. As noted further below (pp. 66-68), this conclusion is directly opposed to an uncontested finding of the Commission here that the site selected is a suitable one for a reactor of the size and type proposed here. As Judge Burger cogently pointed out in his dissent (R. 966):

> "On what evidence does the majority make a finding of 'nuclear disaster' directly opposed to the finding which the Atomic Energy Commission made? The majority is, in effect, telling the Atomic Energy Commission that it has made an *unwise* decision on the location of the plant."

BOTH STATUTORY LANGUAGE AND LEGISLATIVE HISTORY SHOW CONGRESSIONAL INTENT TO AUTHORIZE COMMISSION APPROVAL OF REACTOR LOCATIONS COMPARABLE TO THAT HERE

1. The court plainly indicated that it considered the population distribution around the site to be the single disqualifying factor. It did not merely say that the potential extent of the harm which could theoretically be caused

[34] See especially Brookhaven Report, Part I (R. 879-86) and Appendix A (R. 901-14). Only the letter of transmittal (R. 349-56) and a selected fragment of the text (R. 356-63) of this extensive

by an accident as a result of the population density in the general vicinity must be given due weight in determining whether the degree of protection provided against such accident by the "final design" of the reactor is adequate. The importance of that question is well understood by the Commission as well as by others knowledgeable in this field, but it is not presented at this stage of the proceedings. The court's decision as a practical matter appears to direct the Commission simply not to locate *any* power reactor in an area of population density comparable to that found here, regardless of safeguards which may be provided and evaluated by the Commission as adequate, unless some "compelling reasons" for such location can be found.

The PRDC reactor is located in an area which is essentially rural, not urban or densely populated; the site is near but not in a metropolitan industrial center.[35] This, as noted further below, is just the type of location which Congress contemplated that the Commission would approve for those developmental reactors designed to explore the feasibility of using nuclear energy for the central station generation of electricity. In addition, the reactor is located on a large plot of land which permits a minimum exclusion radius of almost $^3/_5$ths of a mile. These exclusion area and population distribution characteristics are generally comparable to (and more favorable than some of) the corresponding characteristics of the other eight power reactors authorized prior to the decision below to be constructed or operated by private parties as well as several comparable power reactors owned by the Commission, and therefore not required to be licensed, but similarly built or being built as developmental reactors in connection with publicly or pri-

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and highly technical report were printed in the Joint Appendix for use of the court below, since the question of the suitability of this location for any large power reactor was not raised or argued before that court (pp. 66-67, below). The entire report and two of its appendices are now included in the printed record (R. 874-917).

[35] See Finding 19, R. 706-07.

vately owned electric generating facilities. These projects and available published information with respect to the population distribution of nearby areas are listed in the appendix to our petition for certiorari (No. 315), pp. 40-41. See also Government petition for certiorari (No. 453), pp. 61-64.

The court's imposition of an arbitrary limitation on site location thus not only usurps the Commission's function in the very field in which its expertise is of particular importance, but also puts in jeopardy all other licenses and construction permits thus far issued for developmental power reactors, and would as a practical matter seriously retard the further development of nuclear reactors for the generation of electric power, all contrary to the purposes of Congress in enacting the Atomic Energy Act of 1954.

2. If Congress had intended to forbid the Commission to approve power reactors located in other than remote areas except under compelling or extraordinary circumstances, it would certainly have said so in specific terms. Nothing in the Act's provisions indicates such an intent. In view of the extensive hearings held, and of the fact that the Joint Committee on Atomic Energy in 1954 was certainly abreast of nuclear developments as a result of its years of work with the Commission in the administration of the Atomic Energy Act of 1946 (§ 15(b), 60 Stat. 772), Congress was plainly aware of the theoretical seriousness of a reactor accident and of the availability of containment and other designs to provide adequate protection of the public health and safety against such possible occurrence.[36] With this knowledge at hand, it elected to vest in the Commission the authority to evaluate the various complex technical factors involved in approving reactor loca-

[36] For example in 1953 Dr. John C. Bugher, then Director, Division of Biology and Medicine, Atomic Energy Commission, testified that the possible or theoretical dangers of power reactors are such that "In the event of a serious disaster, the locality could be very seriously contaminated and would not be suitable for occupation by people for quite a period of time", although he believed

tion, rather than to spell out rigid rules or criteria in the statute itself.[36]

The legislative history of the 1954 Act shows that Congress was also quite aware that the early large reactors would be located, as in fact they have been, reasonably near large metropolitan centers. For example, Mr. Eugene Zuckert, then a member of the Atomic Energy Commission, testified at hearings on the bill in 1954 that nuclear facilities "would be an integral part of the electric-generating activities of the country," and that large nuclear power plants (100,000 to 300,000 kilowatts or more) "are likely to be built first near heavy power consuming centers." To be competitive, he pointed out, nuclear plants would be located "near but not in" metropolitan and industrial centers (*Hearings Before the Joint Committee on Atomic Energy on S. 3323 and H.R. 8862, to Amend the Atomic Energy Act of 1946*, 83d Cong., 2d Sess. (1954) p. 582, II *Legis. Hist.* 2220). See also statement of Commissioner Smyth (*Hearings, supra*, at p. 570; II *Legis. Hist.* 2208).

In the debates Senator Lehman referred to such testimony when he noted that "the first nuclear reactors for power-producing purposes would very likely be erected in New York State, near the great centers of population in my State" (100 *Cong. Rec.* 11374, III *Legis. Hist.* 3461). In fact, the first construction permit issued by the Commission was for such a reactor, substantially larger than that being built by PRDC, located at Indian Point, New York, approximately twenty-four miles from the New York City limits (see appendix to our petition for certiorari, p. 40).

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that reactors could be so designed as to provide adequate protection against such an occurrence. *Hearings Before the Joint Committee on Atomic Energy on Atomic Power Development and Private Enterprise*, 83d Cong., 1st Sess. (1953), pp. 32-34. See also letter of July 23, 1953 of Dr. Edward Teller, *id.* at p. 633.

[36] See especially Atomic Energy Act of 1954, Section 161 i (3), which specifically empowers the Commission by regulation or order to fix "standards and restrictions governing the design, location, and operation" of authorized facilities, so as to "protect health and to minimize danger to life or property" (Appendix, p. 74).

Senator Hennings voiced a similar understanding, that it was contemplated that "in the future, atomic-energy reactors of various sizes and capacities could be located in any city or town or, for that matter, in a barren field anywhere in the Middle West, as well as any place in the country" (100 *Cong. Rec.* 11920, III *Legis. Hist.* 3681). Senator Kennedy testified in favor of the location of one of the early large developmental plants in New England, emphasizing the importance of "pilot plant activity" and experimental plants to be located in that area (*Hearings, supra*, pp. 774-780, II *Legis. Hist.* 2412-18). Such a plant, of slightly greater capacity than the reactor here involved, has now been constructed and licensed and is in operation at Rowe, Massachusetts, some forty five miles from Albany, New York (see appendix to our petition for certiorari, p. 40).

Even more specifically, there was reference in the hearings on the 1954 Act to the Shippingport Pressurized Water Reactor, the location of which was described in the Commission's 16th semiannual report of July, 1954, as some "25 miles northwest of Pittsburgh,"[38] and which at that very time was under construction by the Commission (*e.g., Hearings, supra*, pp. 471, 493, II *Legis. Hist.* 2105, 2127). This project was described in the Report of the Joint Committee on the bill that became the Atomic Energy Act of 1954 as "the Nation's first large-scale atomic-power reactor, which will generate 60,000 kilowatts of electricity—an amount sufficient to furnish light and power for a sizable city" (Sen. Rep. 1699, H. R. Rep. 2181, 83d Cong., 2d Sess. (1954), p. 3, I *Legis. Hist.* 751, 999).[39]

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[38] *Major Activities in the Atomic Energy Programs, January-July 1954* (AEC, 1954) pp. 21-22.

[39] Among the relatively few Congressional references to the desirability of locating reactors in relatively sparsely settled areas for safety reasons is a statement by Senator Humphrey on the floor of the Senate, where he was urging the Commission to place such a plant in the high power-cost areas of rural Minnesota (100 *Cong. Rec.* 11900, III *Legis. Hist.* 3660). Senator Humphrey would apparently have considered the PRDC location to

Not only did these and other proposed reactors evoke no statutory prohibition on the Commission's power to build or approve such developmental projects or to do so only in extraordinary or compelling cases, but Congress actually wrote into Section 104 b of the Act a mandate to the Commission to lend projects of this nature every encouragement and to impede them by a minimum of regulation (Appendix, pp. 72-73). The restriction imposed by the decision below constitutes a roadblock to nuclear progress of the very type which Congress in Section 104 b enjoined the Commission—and *a fortiori* the courts—not to erect. As Commissioner Zuckert properly pointed out in the 1954 Hearings on the Act (p. 60, above), if reactors are to be developed for the central station generation of electric power, they must be located, like most large conventional power plants, in the service areas of the utilities operating them and reasonably near metropolitan and industrial centers. Congress plainly recognized that a wilderness or desert location is only one of a number of means which may be used "to protect the health and safety of the public," and it plainly did not intend to limit the Commission's discretion in evaluating population distribution along with other factors in approving reactor sites.

B. SUBSEQUENT CONGRESSIONAL ACTION INDICATES APPROVAL OF THE COMMISSION'S REACTOR LOCATION POLICIES

Again, as with its provisional construction permit procedure, the Commission's consistent practice in licensing (and in building itself) large developmental power re-

be satisfactory from this standpoint, however, since in this connection he referred to the Shippingport, Pennsylvania, plant as one of those which were "being constructed in rural areas" *(ibid.)*. The Shippingport reactor is some 30 miles from the center of Pittsburgh and has a substantially greater population within the five-mile (20,000), the ten-mile (125,000) and the fifteen-mile (225,000) radius of the site than does PRDC, and has some 2,800,000 persons living within a forty-mile radius. See appendix to our petition for certiorari (No. 315), p. 41; Government petition for certiorari (No. 454), p. 63.

actors and associated electric generating facilities within reasonable distances of commercial and industrial centers has been brought to the attention of Congress and has evoked no corrective legislation in spite of frequent and pertinent amendment of the Act.

As stated elsewhere, relevant characteristics of nine developmental power reactors and of four other similar Commission-built reactors are listed in the appendix to our petition for certiorari (pp. 40-41). See also appendix to Government petition for certiorari (pp. 61-64). General information on these projects has been regularly furnished to the Joint Committee in the public hearings it has held annually since 1955 under Section 202 of the Act on "Development, Growth and State of the Atomic Energy Industry." Further testimony about many of these and other reactors was given in the extensive Joint Committee hearings held in 1956 and 1957 on proposed indemnity legislation,[40] and still other information has been regularly submitted in connection with annual AEC appropriation authorization bills.[41]

Probably the most extensive consideration of the problem of reactor location as such is found in the Commission's Brookhaven Report, referred to heretofore and relied upon in other particulars by the court below, which was submitted to the Joint Committee in 1957 in connection with its consideration of proposed legislation to provide up to $500,000,000 of indemnification for liability of Commission licensees and contractors which might result

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[40] *Hearings Before the Joint Committee on Atomic Energy on Governmental Indemnity for Private Licensees and AEC Contractors Against Reactor Hazards*, 84th Cong., 2d Sess. (1956); *id. on Governmental Indemnity and Reactor Safety*, 85th Cong., 1st Sess. (1957).

[41] *E.g., Hearings Before the Subcommittee on Legislation of the Joint Committee on Atomic Energy on Authorizing Legislation for AEC's Fiscal Year 1958 Construction Budget*, 85th Cong., 1st Sess. (1957); *id. for Fiscal Year 1959*, 85th Cong., 2d Sess. (1958); *id. on Review of Proposals under Power Demonstration Program*, 85th Cong., 2d Sess. (1958).

from nuclear accidents. In Appendix B of this study (R. 914-17) there was given a summary of the population distribution around a typical power reactor, assumed to be of 500,000 thermal kilowatts.[42] Such reactor was assumed to be "30 miles from a large city, and located near a large body of water." The basis for this assumption was stated to be that "all the power reactor sites proposed to date are within 30 to 40 miles of a city and near an adequate water source."

As further support for the assumption used there was included with the study a chart showing "population curves for three government controlled sites and two proposed private sites" (R. 915-917). As the study states, this chart shows plainly that each of the sites has a remarkably similar population distribution. All of them are closely comparable in this respect to the PRDC location.

The 1957 report of the Joint Committee on the proposed indemnity legislation relied heavily on this and other information submitted to it, including material showing the availability of adequate measures which could be engineered to provide protection for the public health and safety against the large theoretical hazards involved (Sen. Rep. No. 296, H. R. Rep. No. 435, 85th Cong., 1st Sess., p. 2):

> "All of the new reactors which are being built or planned have incorporated into them every conceivable device to see that they are safe. The reactors themselves are constructed with immediate shielding designed to minimize blast damage. They also have gas-tight fragment-proof containers of concrete and steel built around them, such as the sphere which was built around the experimental submarine reactors at West Milton, N. Y. The possibility of dangerous materials escaping and causing damage outside the reactor facilities is infinitesimal. However, the possibility does still exist."

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[42] The PRDC reactor is designed for approximately 300,000 thermal kilowatts, which would permit an output from the plant of approximately 100,000 kilowatts of electricity (Finding 2, R. 701).

"The Commission has extensive powers to protect the public health and safety through its regulatory acts, and it also has mandate for a strong Inspection Division to see that the regulations are complied with. During the hearings, the Commission explained at some length its safety precautions. All of these minimize the possibility of such damage to persons and property."

The Joint Committee report then took note of the estimate in the Commission's Brookhaven Report (the letter of transmittal of which was annexed to the Committee report) that there was less than one chance in 50 million of a member of the public getting killed in any year from a reactor accident, as compared to one chance in 5,000 of getting killed in an automobile accident (Sen. Rep. No. 296, H. R. Rep. No. 435, *supra*, p. 3), and recommended the enactment of the proposed indemnity legislation. As pointed out heretofore (pp. 49-51), the Joint Committee also in the same report recommended certain procedural amendments to Sections 182 and 189 of the Act, stating that, in addition to providing Governmental indemnity, "Congress should also provide all possible statutory requirements for assuring that reactors should be as safe as possible" (*id.* at p. 12).

One member of the Joint Committee opposed the indemnity legislation in both 1956 and 1957.[43] In his separate views attached to the Joint Committee's favorable report on the bill in 1956 Representative Holifield emphasized (as did the court below) the extent of the potential damage which might result from a reactor accident and urged that "the quickest and safest way to progress is to build reactors at present Government-owned isolated sites," thus obviating the necessity for any indemnity legislation. H. R. Rep. No. 2531, 84th Cong., 2d Sess. (1956), p. 21. In separate views submitted with the Joint Committee's 1957

[43] The indemnity amendments were first recommended by the Joint Committee in 1956, but failed to pass before adjournment of the 84th Congress. See Sen. Rep. No. 2298, H. R. Rep. No. 2531, 84th Cong., 2d Sess. (1956).

report, he again opposed the indemnity legislation as "unnecessary and unwise," stating that "until we can prove by a history of experience in the operation of the new and unproven power reactors (which are now planned) that they are safe mechanisms, we should insist they be located safe distances from populated centers" (H. R. Rep. No. 435, 85th Cong., 1st Sess. (1957), pp. 39, 40). Both the Joint Committee and the Congress disagreed, however, and the indemnity legislation was enacted, together with only those amendments to the licensing provisions noted above. No provision was recommended by the Joint Committee or included in the amendments as passed to limit the Commission's discretion to evaluate population density around a site along with other factors in determining its suitability for a power reactor (Sen. Rep. No. 296, H. R. Rep. No. 435, *supra*; P.L. 85-256, 71 Stat. 576). On the contrary, the provisions of the indemnity amendment itself recognized the necessity for considering location along with other factors in evaluating reactor hazards.[44]

C. THE COMMISSION'S UNCONTESTED FINDING THAT THE SITE HERE IS SUITABLE IS CONTROLLING

The alternative holding of the court with respect to reactor location was made in the face of an uncontested finding by the Commission that the site chosen here was a suitable one for a reactor of this size and type.

On the only safety issue presented below, the respondents' argument was that the Commission had failed to make sufficiently definitive findings with respect to the safety of operation of this reactor prior to issuance of a construction permit (discussed above, pp. 25 to 54).[45] No contention was advanced at any time that the site

[44] Subsections 170 b and f provide that, in determining the amount of financial protection which each reactor operator is to have as a prerequisite to obtaining Government indemnification up to $500,000,000 for any one incident, and as a basis for fixing the indemnification fees, the Commission may take into consideration "the type, size, and location" as well as "other factors pertaining to the hazard". See Appendix, pp. 75-76.

[45] R. 951-53; see also "Statement of Points" in respondents' Brief in Court of Appeals, p. 10 (lodged with the Clerk of this Court).

was unsuitable for *any* reactor of comparable size, or that it was unsuitable for *this* reactor if the reactor was otherwise shown to be safe, or that the Commission must justify approval of such a location by finding "compelling reasons" for its selection.[46]

Apart from the implications which such a contention would have for the whole nuclear power development program, a valid explanation of why it was not urged to the court below is found in the fact that the Commission made unambiguous and uncontested findings that this site *is* suitable for a power reactor of such size and type. In addition to the finding discussed in Point I above (pp. 34-35) of reasonable assurance that a reactor of the general type proposed can be operated "at the location without undue risk" (Finding 22, R. 708), the Commission also found that

> "There is reasonable assurance that the proposed site is generally suitable for a reactor of the type and size described in the Application, if the reactor is otherwise shown to be capable of operation without undue risk to the public health and safety, including demonstrations of stability and adequate containment" (Finding 32, R. 710-11).

As explained above (p. 8), it is undisputed that the potential or conceivable danger to the public from any reactor lies not in damage from explosion or blast, but in the accidental release to the environment of toxic fission products accumulated in it; every reactor creates such fission products in the course of operation, and their potential quantity is primarily a function of its size or power and

[46] At the hearing before the Commission the respondents contended that, because of the nature of this particular reactor, it or a prototype should first have been tested out in a remote location. On the basis of the evidence the Commission made a finding, not attacked here, that such a prototype had not been shown to be necessary from a safety standpoint (Finding 17, R. 705-06). At no time did respondents question the suitability of the location for a power reactor as such. Compare *United States* v. *Tucker Truck Lines, Inc.*, 344 U.S. 33, 36-37; *Federal Power Commission* v. *Colorado Interstate Gas Co.*, 348 U.S. 492, 498-501.

extent of operation, and secondarily of its general type. Hence, in initially approving the suitability of a site, the Commission must evaluate it, as it did here, in terms of the size and type of the proposed reactor, subject to a later definitive showing of the safety of "the final design".

The Commission further found (Finding 21, R. 707-08):

> "A definitive evaluation of the suitability of the proposed reactor depends upon the inherent safety of the reactor and a demonstration that no credible accident can release significant quantities of fission products into the atmosphere. If the foregoing are established, and there is reasonable assurance that they can be, the site will prove suitable for the proposed reactor."

These findings were neither quoted nor cited by the court below. Other statements in the Commission's findings with respect to site, some of which were so quoted (R. 964-65), have to do largely with the development of further data with respect to meteorology, hydrology and the like (R. 677-78, 706-08). When fully compiled and evaluated, these data could indicate that additional protective measures or operating restrictions are or are not needed, but the undisputed testimony is that such further information, by its nature, could not render the site unsuitable as such for a large power reactor.[47] Hence the Commission's finding that the site was suitable for a reactor of this size and type, if what its regulation calls "the final design" is shown to have adequate protective structures and devices, was definitive. As noted above, no contention is made that this or any other safety or site finding was not supported by the evidence.

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[47] R. 108-10. The testimony is also undisputed that the extensive meteorological and other site data which the Commission requires prior to authorizing reactor operation and determining any limitations thereon, is information which, by its nature, takes several years to accumulate and in practically every instance is not fully available at the outset of construction but must be gathered as construction progresses. See, *e.g.*, Tr. 3804, 4258-59 (not printed).

CONCLUSION

In both aspects of its decision, a majority of the court below has pre-empted the roles of Congress and the Commission by writing into the law its particular ideas of what would be sound atomic energy policy. It has done so with respect to matters that were not only plainly entrusted to the Atomic Energy Commission's expert discretion by Congress, but that fall in an area which, above all others, requires the evaluation of complex technical information by those specially qualified to do this. If either of the holdings of the court below stands, it will impede rather than further the plainly declared Congressional purpose of encouraging the most rapid development of the peaceful application of nuclear energy which is consistent with adequate protection of the public health and safety.

The judgment below should be reversed.

Respectfully submitted,

JOHN LORD O'BRIAN,
W. GRAHAM CLAYTOR, JR.,
DAVID E. MCGIFFERT,
701 Union Trust Building,
Washington 5, D. C.

EDWARD S. REID, JR.,
RICHARD B. GUSHEE,
3456 Penobscot Building,
Detroit 26, Michigan.

Attorneys for Petitioner
Power Reactor Development Company

COVINGTON & BURLING,
Washington, D. C.

MILLER, CANFIELD, PADDOCK AND STONE,
Detroit, Michigan

Of Counsel

FEBRUARY 13, 1961.

APPENDIX

I. Pertinent Provisions of Statutes

1. Atomic Energy Act of 1954, As Amended, Sections 1, 3a, d, 53 f, 101, 102, 103, 104, 161 b, i, p, 170 a, b, c, j, 182, 185, 189, 201, 202, 68 Stat. 921, 922, 931, 936, 937, 948, 953, 955, 956, 70 Stat. 1070, 1071, 71 Stat. 576; 42 U.S.C. §§ 2011, 2013(a), (d), 2073(f), 2131, 2132, 2133, 2134, 2201(b), (i), (p), 2210(a), (b), (c), (f), 2232, 2235, 2239, 2251, 2252.

Section 1. Declaration.—Atomic energy is capable of application for peaceful as well as military purposes. It is therefore declared to be the policy of the United States that—

a. the development, use, and control of atomic energy shall be directed so as to make the maximum contribution to the general welfare, subject at all times to the paramount objective of making the maximum contribution to the common defense and security; and

b. the development, use, and control of atomic energy shall be directed so as to promote world peace, improve the general welfare, increase the standard of living, and strengthen free competition in private enterprise.

* * * * *

Sec. 3. Purpose.—It is the purpose of this Act to effectuate the policies set forth above by providing for—

a. a program of conducting, assisting, and fostering research and development in order to encourage maximum scientific and industrial progress;

* * * *

d. a program to encourage widespread participation in the development and utilization of atomic energy for peaceful purposes to the maximum extent consistent with the common defense and security and with the health and safety of the public;

* * * * *

Sec. 53. Domestic Distribution of Special Nuclear Material.—

* * * * *

f. The Commission is directed to distribute within the United States sufficient special nuclear material to permit the conduct of widespread independent research

and development activities to the maximum extent practicable and within the limitations set by the President pursuant to section 41. In the event that applications for special nuclear material exceed the amount available for distribution, preference shall be given to those activities which are most likely, in the opinion of the Commission, to contribute to basic research, to the development of peacetime uses of atomic energy, or to the economic and military strength of the Nation.

* * * * *

SEC. 101. LICENSE REQUIRED.—It shall be unlawful, except as provided in section 91, for any person within the United States to transfer or receive in interstate commerce, manufacture, produce, transfer, acquire, possess, use, import, or export any utilization or production facility except under and in accordance with a license issued by the Commission pursuant to section 103 or 104.

SEC. 102. FINDING OF PRACTICAL VALUE. Whenever the Commission has made a finding in writing that any type of utilization or production facility has been sufficiently developed to be of practical value for industrial or commercial purposes, the Commission may thereafter issue licenses for such type of facility pursuant to section 103.

SEC. 103. COMMERCIAL LICENSES.

a. Subsequent to a finding by the Commission as required in section 102, the Commission may issue licenses to transfer or receive in interstate commerce, manufacture, produce, transfer, acquire, possess, use, import, or export under the terms of an agreement for cooperation arranged pursuant to section 123, such type of utilization or production facility. Such licenses shall be issued in accordance with the provisions of chapter 16 and subject to such conditions as the Commission may by rule or regulation establish to effectuate the purposes and provisions of this Act.

b. The Commission shall issue such licenses on a nonexclusive basis to persons applying therefor (1) whose proposed activities will serve a useful purpose proportionate to the quantities of special nuclear material or source material to be utilized; (2) who are equipped to observe and who agree to observe such safety standards to protect health and to minimize danger to life

or property as the Commission may by rule establish; and (3) who agree to make available to the Commission such technical information and data concerning activities under such licenses as the Commission may determine necessary to promote the common defense and security and to protect the health and safety of the public. All such information may be used by the Commission only for the purposes of the common defense and security and to protect the health and safety of the public.

c. Each such license shall be issued for a specified period, as determined by the Commission, depending on the type of activity to be licensed, but not exceeding forty years, and may be renewed upon the expiration of such period.

d. No license under this section may be given to any person for activities which are not under or within the jurisdiction of the United States, except for the export of production or utilization facilities under terms of an agreement for cooperation arranged pursuant to section 123, or except under the provisions of section 109. No license may be issued to an alien or any corporation or other entity if the Commission knows or has reason to believe it is owned, controlled, or dominated by an alien, a foreign corporation, or a foreign government. In any event, no license may be issued to any person within the United States if, in the opinion of the Commission, the issuance of a license to such person would be inimical to the common defense and security or to the health and safety of the public.

SEC. 104. MEDICAL THERAPY AND RESEARCH AND DEVELOPMENT.—

a. The Commission is authorized to issue licenses to persons applying therefor for utilization facilities for uses in medical therapy. In issuing such licenses the Commission is directed to permit the widest amount of effective medical therapy possible with the amount of special nuclear material available for such purposes and to impose the minimum amount of regulation consistent with its obligations under this Act to promote the common defense and security and to protect the health and safety of the public.

b. The Commission is authorized to issue licenses to persons applying therefor for utilization and pro-

duction facilities involved in the conduct of research and development activities leading to the demonstration of the practical value of such facilities for industrial or commercial purposes. In issuing licenses under this subsection, the Commission shall impose the minimum amount of such regulations and terms of license as will permit the Commission to fulfill its obligations under this Act to promote the common defense and security and to protect the health and safety of the public and will be compatible with the regulations and terms of license which would apply in the event that a commercial license were later to be issued pursuant to section 103 for that type of facility. In issuing such licenses, priority shall be given to those activities which will, in the opinion of the Commission, lead to major advances in the application of atomic energy for industrial or commercial purposes.

c. The Commission is authorized to issue licenses to persons applying therefor for utilization and production facilities useful in the conduct of research and development activities of the types specified in section 31 and which are not facilities of the type specified in subsection 104b. The Commission is directed to impose only such minimum amount of regulation of the licensee as the Commission finds will permit the Commission to fulfill its obligations under this Act to promote the common defense and security and to protect the health and safety of the public and will permit the conduct of widespread and diverse research and development.

d. No license under this section may be given to any person for activities which are not under or within the jurisdiction of the United States, except for the export of production or utilization facilities under terms of an agreement for cooperation arranged pursuant to section 123 or except under the provisions of section 109. No license may be issued to any corporation or other entity if the Commission knows or has reason to believe it is owned, controlled, or dominated by an alien, a foreign corporation, or a foreign government. In any event, no license may be issued to any person within the United States if, in the opinion of the Commission, the issuance of a license to such person would be inimical to the common defense and security or to the health and safety of the public.

* * * * *

SEC. 161. GENERAL PROVISIONS.—In the performance of its functions the Commission is authorized to—

* * * *

b. establish by rule, regulation, or order, such standards and instructions to govern the possession and use of special nuclear material, source material, and byproduct material as the Commission may deem necessary or desirable to promote the common defense and security or to protect health or to minimize danger to life or property;

* * * *

i. prescribe such regulations or orders as it may deem necessary (1) to protect Restricted Data received by any person in connection with any activity authorized pursuant to this Act, (2) to guard against the loss or diversion of any special nuclear material acquired by any person pursuant to section 53 or produced by any person in connection with any activity authorized pursuant to this Act, and to prevent any use or disposition thereof which the Commission may determine to be inimical to the common defense and security, and (3) to govern any activity authorized pursuant to this Act, including standards and restrictions governing the design, location, and operation of facilities used in the conduct of such activity, in order to protect health and to minimize danger to life or property;

* * * *

p. make, promulgate, issue, rescind, and amend such rules and regulations as may be necessary to carry out the purposes of this Act;

* * * *

SEC. 170. INDEMNIFICATION AND LIMITATION OF LIABILITY.[1]

a. Each license issued under section 103 or 104 and each construction permit issued under section 185 shall, and each license issued under section 53, 63, or 81 may, have as a condition of the license a requirement that the licensee have and maintain financial protection of such type and in such amounts as the Commission

[1] This section was added by P.L. 85-256, 71 Stat. 576 (1957).

shall require in accordance with subsection 170 b. to cover public liability claims. Whenever such financial protection is required, it shall be a further condition of the license that the licensee execute and maintain an indemnification agreement in accordance with subsection 170 c. The Commission may require, as a further condition of issuing a license, that an applicant waive any immunity from public liability conferred by Federal or State law.

b. The amount of financial protection required shall be the amount of liability insurance available from private sources, except that the Commission may establish a lesser amount on the basis of criteria set forth in writing, which it may revise from time to time, taking into consideration such factors as the following: (1) the cost and terms of private insurance, (2) the type, size, and location of the licensed activity and other factors pertaining to the hazard, and (3) the nature and purpose of the licensed activity: *Provided*, That for facilities designed for producing substantial amounts of electricity and having a rated capacity of 100,000 electrical kilowatts or more, the amount of financial protection required shall be the maximum amount available from private sources. Such financial protection may include private insurance, private contractual indemnities, self insurance, other proof of financial responsibility, or a combination of such measures.

c. The Commission shall, with respect to licenses issued between August 30, 1954, and August 1, 1967, for which it requires financial protection, agree to indemnify and hold harmless the licensee and other persons indemnified, as their interest may appear, from public liability arising from nuclear incidents which is in excess of the level of financial protection required of the licensee. The aggregate indemnity for all persons indemnified in connection with each nuclear incident shall not exceed $500,000,000 including the reasonable costs of investigating and settling claims and defending suits for damage. Such a contract of indemnification shall cover public liability arising out of or in connection with the licensed activity.

* * * * *

f. The Commission is authorized to collect a fee from all persons with whom an indemnification agree-

ment is executed under this section. This fee shall be $30 per year per thousand kilowatts of thermal energy capacity for facilities licensed under section 103. For facilities licensed under section 104, and for construction permits under section 185, the Commission is authorized to reduce the fee set forth above. The Commission shall establish criteria in writing for determination of the fee for facilities licensed under section 104, taking into consideration such factors as (1) the type, size, and location of facility involved, and other factors pertaining to the hazard, and (2) the nature and purpose of the facility. For other licenses, the Commission shall collect such nominal fees as it deems appropriate. No fee under this subsection shall be less than $100 per year.

* * * * *

SEC. 182. LICENSE APPLICATIONS.—

a. Each application for a license hereunder shall be in writing and shall specifically state such information as the Commission, by rule or regulation, may determine to be necessary to decide such of the technical and financial qualifications of the applicant, the character of the applicant, the citizenship of the applicant, or any other qualifications of the applicant as the Commission may deem appropriate for the license. In connection with applications for licenses to operate production or utilization facilities, the applicant shall state such technical specifications, including information of the amount, kind, and source of special nuclear material required, the place of the use, the specific characteristics of the facility, and such other information as the Commission may, by rule or regulation, deem necessary in order to enable it to find that the utilization or production of special nuclear material will be in accord with the common defense and security and will provide adequate protection to the health and safety of the public. Such technical specifications shall be a part of any license issued. The Commission may at any time after the filing of the original application, and before the expiration of the license, require further written statements in order to enable the Commission to determine whether the application should be granted or denied or whether a license should be modified or revoked. All applications and statements

shall be signed by the applicant or licensee. Applications for, and statements made in connection with, licenses under sections 103 and 104 shall be made under oath or affirmation. The Commission may require any other applications or statements to be made under oath or affirmation.

b. The Advisory Committee on Reactor Safeguards shall review each application under section 103 or 104 b. for a license for a facility, any application under section 104 c. for a testing facility, and any application under section 104 a. or c. specifically referred to it by the Commission, and shall submit a report thereon, which shall be made part of the record of the application and available to the public, except to the extent that security classification prevents disclosure.[1]

c. The Commission shall not issue any license for a utilization or production facility for the generation of commercial power under section 103, until it has given notice in writing to such regulatory agency as may have jurisdiction over the rates and services of the proposed activity, to municipalities, private utilities, public bodies, and cooperatives within transmission distance authorized to engage in the distribution of electric energy and until it has published notice of such application once each week for four consecutive weeks in the Federal Register, and until four weeks after the last notice.

d. The Commission, in issuing any license for a utilization or production facility for the generation of commercial power under section 103, shall give preferred consideration to applications for such facilities which will be located in high cost power areas in the United States if there are conflicting applications for a limited opportunity for such license. Where such conflicting applications resulting from limited opportunity for such license include those submitted by public or cooperative bodies such applications shall be given preferred consideration.

[1] This subsection was added and original subsections "b" and "c" were relettered respectively "c" and "d" by P.L. 85-256, 71 Stat. 576 (1957).

SEC. 185. CONSTRUCTION PERMITS.—All applicants for licenses to construct or modify production or utilization facilities shall, if the application is otherwise acceptable to the Commission, be initially granted a construction permit. The construction permit shall state the earliest and latest dates for the completion of the construction or modification. Unless the construction or modification of the facility is completed by the completion date, the construction permit shall expire, and all rights thereunder be forfeited, unless upon good cause shown, the Commission extends the completion date. Upon the completion of the construction or modification of the facility, upon the filing of any additional information needed to bring the original application up to date, and upon finding that the facility authorized has been constructed and will operate in conformity with the application as amended and in conformity with the provisions of this Act and of the rules and regulations of the Commission, and in the absence of any good cause being shown to the Commission why the granting of a license would not be in accordance with the provisions of this Act, the Commission shall thereupon issue a license to the applicant. For all other purposes of this Act, a construction permit is deemed to be a "license."

* * * * * *

SEC. 189. HEARINGS AND JUDICIAL REVIEW.—

a. In any proceeding under this Act, for the granting, suspending, revoking, or amending of any license or construction permit, or application to transfer control, and in any proceeding for the issuance or modification of rules and regulations dealing with the activities of licensees, and in any proceeding for the payment of compensation, an award or royalties under sections 153, 157, 186 c., or 188, the Commission shall grant a hearing upon the request of any person whose interest may be affected by the proceeding, and shall admit any such person as a party to such proceeding. The Commission shall hold a hearing after thirty days notice and publication once in the Federal Register on each application under section 103 or 104 b. for a license for a facility, and on any application under section 104 c. for a license for a testing facility.[1]

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[1] The last sentence of Sec. 189 a was added by P.L. 85-256, 71 Stat. 576 (1957).

b. Any final order entered in any proceeding of the kind specified in subsection a. above shall be subject to judicial review in the manner prescribed in the Act of December 29, 1950, as amended (ch. 1189, 64 Stat. 1129), and to the provisions of section 10 of the Administrative Procedure Act, as amended.

* * * * *

SEC. 201. MEMBERSHIP.—There is hereby established a Joint Committee on Atomic Energy to be composed of nine Members of the Senate to be appointed by the President of the Senate, and nine Members of the House of Representatives to be appointed by the Speaker of the House of Representatives. In each instance not more than five Members shall be members of the same political party.

SEC. 202. AUTHORITY AND DUTY.—The Joint Committee shall make continuing studies of the activities of the Atomic Energy Commission and of problems relating to the development, use, and control of Atomic energy. During the first sixty days of each session of the Congress, the Joint Committee shall conduct hearings in either open or executive session for the purpose of receiving information concerning the development, growth, and state of the atomic energy industry. The Commission shall keep the Joint Committee fully and currently informed with respect to all of the Commission's activities. The Department of Defense shall keep the Joint Committee fully and currently informed with respect to all matters within the Department of Defense relating to the development, utilization, or application of atomic energy. Any Government agency shall furnish any information requested by the Joint Committee with respect to the activities or responsibilities of that agency in the field of atomic energy. All bills, resolutions, and other matters in the Senate or the House of Representatives relating primarily to the Commission or to the development, use, or control of atomic energy shall be referred to the Joint Committee. The members of the Joint Committee who are Members of the Senate shall from time to time report to the Senate, and the members of the Joint Committee who are Members of the House of Representatives shall from time to time report to the House, by bill or otherwise, their recommendations with respect to matters within the jurisdiction of their respective Houses which are referred to the Joint Committee or otherwise within the jurisdiction of the Joint Committee.

II. Pertinent Provisions of Regulations

Section 50.34. *Contents of applications; technical information hazards summary report.* Each application shall state the following technical information:

(a) A description of the chemical, physical, metallurgical, or nuclear process to be performed, and a statement of the kind and quantity of any radioactive effluent expected to result from the process. The description of the process should be sufficiently detailed to permit evaluation of the radioactive hazards involved. The magnitude of the proposed operation should be indicated in terms of the amount and radioactivity of source, special nuclear, or by-product material to be handled per unit of time, and thermal power to be generated if any.

(b) A description of the facility. The description should be based on the design criteria for the facility as a whole and for those major component parts which are essential to the safe operation of the facility, and should be presented in sufficient detail to allow an evaluation of the adequacy of the various means proposed to minimize the probability of danger from radioactivity to persons both on and off-site. The description should also cover any activities, other than those subject to license, proposed to be carried on in the building which will house the facility and on the balance of the site.

(c) A description of the site on which the facility is to be located. This should include a map of the area showing the location of the site and indicating the use to which the surrounding land is put, i.e., industrial, commercial, agricultural, residential; location of sources of potable or industrial water supply, watershed areas and public utilities; and a scale plot plan of the site showing the proposed location of the facility.

(d) A description of proposed procedures for: routine and non-routine operations, start-up and shut-down, maintenance, storage, training of employees, minimizing operational mishaps (such as locked controls, checklists, and close supervision), investigating unusual or unexpected incidents; and a description of such other details as may be useful in evaluating the existence and effectiveness of safeguards against the radioactive hazards in the operation of the facility.

(e) A description of plans or proposals in the event that acts or accidents occur which would create radioactive

hazards. The description should relate the various operational procedures, the protective devices, and the pertinent features of the site, to such happenings as operational mistakes, equipment or instrument failure or malfunction, fire, electric power failure, flood, earthquake, storm, strike, and riot.

(f) Meteorological, hydrological, geological, and seismological data necessary for evaluating the measures proposed for protecting the public against possible radioactive hazards.

(g) An evaluation of the proposed measures and devices to prevent acts or accidents which would create radioactive hazards or to protect against the consequences should such acts or accidents occur.

(h) A description of procedures for disposal of radioactive solid waste and the final disposal of liquid waste effluent.

(i) A description of means provided to sample atmosphere discharges through stacks where such stacks may emit by-product material or special nuclear material.

SECTION 50.35. *Extended time for providing technical information.* Where, because of the nature of a proposed project, an applicant is not in a position to supply initially all of the technical information otherwise required to complete the application, he shall indicate the reason, the items or kinds of information omitted, and the approximate times when such data will be produced. If the Commission is satisfied that it has information sufficient to provide reasonable assurance that a facility of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public and that the omitted information will be supplied, it may process the application and issue a construction permit on a provisional basis without the omitted information subject to its later production and an evaluation by the Commission that the final design provides reasonable assurance that the health and safety of the public will not be endangered.

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No. 315 and No. 454

IN THE

Supreme Court of the United States

OCTOBER TERM, 1960

POWER REACTOR DEVELOPMENT COMPANY, PETITIONER,

v.

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL-CIO, ET AL. RESPONDENTS

UNITED STATES OF AMERICA AND ATOMIC ENERGY COMMISSION, PETITIONERS,

v.

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL-CIO, ET AL., RESPONDENTS

ON WRITS OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

BRIEF FOR RESPONDENTS

BENJAMIN C. SIGAL,
1126 16th Street, N. W.,
Washington, D. C.
Attorney for Respondents.

HAROLD CRANEFIELD,
LOWELL GOERLICH.
Of Counsel.

MARCH 1961.

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Supreme Court of the United States

OCTOBER TERM, 1960

No. 315 and No. 454

POWER REACTOR DEVELOPMENT COMPANY, PETITIONER,

v.

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL-CIO, ET AL. RESPONDENTS

UNITED STATES OF AMERICA AND ATOMIC ENERGY COMMISSION, PETITIONERS,

v.

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL-CIO, ET AL. RESPONDENTS

ON WRITS OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

BRIEF FOR RESPONDENTS

Opinion Below

The Opinion of the Court of Appeals (R. 953-968)[1] is reported at 280 F.2d 645.

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[1] Citations indicated by "R. ——" are to the 3 volumes of the printed record in this Court. In Volumes I and II, the pagination referred to appears at the bottom of each page; the pagination at the top of the page is the original pagination of the certified record. In Volume III, the pagination referred to appears at the top of each page.

Citations indicated by "Tr. ——" are to unprinted pages of the certified record of the proceedings before the Commission, which has been filed with the Clerk of this Court.

Petitions for a rehearing *en banc* were denied without opinion by Chief Judge Prettyman and Circuit Judges Danaher, Fahy, Edgerton, and Bazelon, with Circuit Judges Bastian and Miller dissenting. (R. 970-971).

The Opinion and Final Decision (R. 630-712), and Order (R. 713-744) of the Atomic Energy Commission, are not reported.

Jurisdiction

The judgment of the court below was entered on June 10, 1960, (R. 969), and petitions for rehearing *en banc* by Power Reactor Development Company, hereinafter referred to as PRDC, and the United States and the Atomic Energy Commission, hereinafter sometimes referred to jointly as Government, were denied on July 25, 1960. PRDC filed a petition for writ of certiorari on August 12, 1960, (No. 315) and the Government filed a petition for writ of certiorari on September 29, 1960 (No. 454). Both petitions were granted on November 14, 1961, limited to the first two questions presented in the petitions, and the cases were consolidated for oral argument. (R. 972, 973; 364 U.S. 889). The jurisdiction of this court rests on 5 U.S.C. 1040 and 28 U.S.C. 1254 (1).

Questions Presented

1. Whether the Atomic Energy Commission violated the Atomic Energy Act of 1954 and its own regulations by issuing a permit for the construction of an atomic energy reactor without finding that there was information sufficient to provide reasonable assurance that the reactor could be operated at the proposed site without undue risk to the health and safety of the public.[2]

[2] This includes what the Government calls "a subsidiary question" (Brief, No. 454, p. 2, note), namely, whether, as the court below held (R. 963) "the Commission's findings regarding safety of operation are ambiguous."

2. Whether one of the grounds of decision of the court below is that the Act precludes the Commission from authorizing construction of an atomic energy power reactor on a site close to a densely populated area unless the Commission finds that there are "compelling reasons" therefor.

Statutes and Regulations Involved

The pertinent provisions of the Atomic Energy Act of 1954, and of the Commission's regulations, are set forth in Appendix A *infra*, pp. 91-99.

Statement

1. *Proceedings before the Commission*

On January 6, 1956, PRDC filed an application for a license under Section 104 of the Act to design, construct and operate a developmental fast neutron breeder reactor at Lagoona Beach, Michigan (R. 364-394).

On June 6, 1956, the Commission's Advisory Committee on Reactor Safeguards submitted a unanimous report to the General Manager of the Commission summarizing its investigation of the proposed reactor, (R. 587-593) and concluded, in part, that, "the Committee believes there is insufficient information available at this time to give assurance that the PRDC reactor can be operated at this site without public hazard" (R. 588). This report was not made available to the public until October 8, 1956.[3]

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[3] The Commission initially refused to make a copy of this report available even to the Congressional Joint Committee on Atomic Energy, on the grounds that the Commission's independence would be impaired and its regulatory functions impeded, but nevertheless offered it on an "administratively confidential" basis. *A study of AEC Procedures and Organization in the Licensing of Reactor Facilities*, 85th Congress, 1st Session, Joint Committee Printing, pp. 117, 118. When the Joint Committee rejected the report on this basis, the Commission transmitted the report without conditions, and on October 9, 1956, admitted that the effort to put a "confidential" label on the report was a mistake (Id. pp. 119-122).

On August 4, 1956, the Commission, by a majority vote, granted a construction permit to PRDC to build its proposed reactor. (R. 516-523).[4] The permit recognized that:

"(1) There are identified areas of uncertainty regarding the hazards potential of fast neutron breeder reactors that must be investigated and resolved. From the current state of the technology applicable to such reactors it can reasonably be inferred that there may be other areas of uncertainty not yet identified and requiring investigation and resolution. Of primary importance among the identified areas of uncertainty are:

"(a) Whether there exists in the PRDC reactor a positive component of the temperature coefficient similar to that exhibited in the Commission's experimental breeder reactor (EBR-1). The source of the positive component of the temperature coefficient exhibited by EBR-1 (presently believed to be caused by dimensional distortion of the core structure) must be identified and its effect, if any, in the PRDC reactor must be eliminated.

"(b) Whether there is a credible condition of meltdown and reassembly of the fuel of the PRDC reactor which could result in an *explosion* that would breach the gas-tight building surrounding the reactor. Further investigations must be carried out to establish that a credible condition of meltdown with consequent U-235 accumulation of critical dimensions cannot result in such an explosion.

"(2) On the basis of information presently available,

[4] Commissioner Thomas E. Murray dissented on the ground that the information then before the Commission "was insufficient to provide reasonable assurance that a facility of the general type proposed could be constructed and operated at the proposed location without undue risk to the health and safety of the public." He relied principally on the report of the Advisory Committee on Reactor Safeguards. (R. 586)

the Commission believes that the problems relating to safety of *operation* of the PRDC reactor will prove to be of a kind that can be satisfactorily resolved within a reasonable time. There is some doubt whether they can be resolved in time to meet the schedule proposed by PRDC in its application and it may turn out that further investigations beyond the program of investigation outlined by PRDC in its application will be needed." (Emphasis added). (R. 517, 518).

The date fixed for completion of the reactor was December 15, 1960. (R. 519).

On or about August 31, 1956, United Automobile, Aircraft and Agricultural Implement Workers of America, AFL-CIO, International Union of Electrical, Radio and Machine Workers, AFL-CIO, and International Union, United Paperworkers of America, AFL-CIO, and their officers, Respondents here, filed petitions for intervention before the Commission (R. 524-570), alleging, *inter alia*, that the construction permit granted to PRDC was issued in violation of the Act, (R. 529-537), and that there was reasonable ground for believing that, after the expenditure of $45 million for construction of the reactor, permission to operate would be issued without proper consideration of and regard for the health and safety of the Respondents and other mem-

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[5] Senator Anderson, Chairman of the Joint Committee on Atomic Energy at the time, vigorously criticized issuance of the construction permit because, *inter alia*, (1) a public hearing had not been held despite the grave doubts as to safety raised by its "distinguished committee of experts," (2) the Commission confused "development and promotion functions with its regulative and quasi-judicial responsibilities," and, (3) "AEC might feel obligated to go on through with a bad deal with respect to public safety because they will have permitted the expenditure of huge sums under the construction permit." *A Study of AEC Procedures*, etc. *supra*, pp. 125, 126. See, also, statement of Representative Holifield, then a member of the Joint Committee, and now its Chairman, to the same effect. (Ibid. pp. 126-127.)

bers of the public (R. 540). They requested immediate suspension of the construction permit pending final determination of the issues raised.

On October 8, 1956, the Commission granted Respondents leave to intervene (R. 576-593), denied the request for suspension of the construction permit (R. 579),[6] and directed that a hearing be held on issues specified by the Commission (R. 577-578). The issue relating to safety was specified as follows:

> "A.1. Whether there is information sufficient to provide reasonable assurance that a utilization facility of the general type proposed by PRDC can be constructed and operated at the Lagoona Beach site without undue risk to the health and safety of the public.
>
> "2. Whether there is reasonable assurance that technical information omitted from and required to complete the application will be supplied." (R. 578).

The Commission also specified the following issue:

> "B. Whether, pursuant to Section 50.40 (b) of the Commission's regulations, the applicant is financially qualified to engage in the proposed activities; and whether, pursuant to Section 50.60 (c) (2) of the Commission's regulations, the applicant is financially qualified to receive an allocation of special nuclear material." (R. 578).

The Commission rejected efforts by both Respondents and PRDC to modify and enlarge the issues (Tr. 6399, 6407, 6416, 6426, 6440).

On December 10, 1956, PRDC filed its "Amendment No. 5 to Application For License" in which it requested exemp-

[6] Commissioner Thomas E. Murray dissented from the Commission's refusal to suspend the construction permit (R. 586, 587).

tions from several regulations of the Commission, including the following (R. 396-397):

> "1) Applicant applies for exemption from the requirement of 10 C.F.R. 50.35 that the Commission be satisfied in connection with the issuance of a construction permit on a provisional basis that 'it has information sufficient to provide reasonable assurance that a facility of the general type proposed can be * * * *operated* at the proposed location without undue risk to the health and safety of the public * * * * *'* (Emphasis in original).

During the course of an extensive hearing that began on January 8, 1957, it was shown that the greatest potential hazard in the operation of a nuclear reactor lies in the possibility that the tremendous accumulation of radioactive fission products imprisoned in the fuel might somehow, including a breach of the containment, be released into the atmosphere, be distributed by wind, and contaminate inhabited areas.[7] A chain of events which could lead to a release of fission products into the atmosphere may be initiated either by a nuclear runaway or a loss of coolant, and the initial concern from a safety point of view must be, so far as is humanly possibly, to make certain that such a nuclear runaway or loss of coolant cannot occur. (Tr. 4267, 4268). These fission products are more toxic per unit of weight than any other industrially known materials by a

[7] Petitioners emphasize that there is no danger of a reactor accident resembling an atomic bomb explosion. This is only a half truth. A nuclear accident may result in a nuclear flash causing a spread of fission products through openings in the containment, such as flues and stacks, as well as radiation through the walls of the containment even if there is no spread of fission products. Sir John Cockcroft, Britain's leading nuclear scientist, has stated that the accident at the Windscale reactor in England in October 1957, which resulted in passage of radioactive gases through the reactor's chimney stacks, *released considerably more radioactivity than is released during an explosion of an atomic bomb of the Hiroshima type.* (Manchester Guardian, March 19, 1958)

factor of a million to a billion (R. 71). An official Commission report, titled "*Theoretical Possibilities and Consequences of Major Accidents in Large Nuclear Power Plants*" (R. 349-363), concludes that the possible damage from a major accident in a large power plant may run up to $7 billion, killing 3400, injuring 43,000 people, and laying waste scores of thousands of square miles of land (R. 353).[8] More than 2,000,000 people live within a radius of 30 miles of the site of the PRDC reactor (R. 707). The major part of the evidence related to the extent to which the PRDC design has solved, if at all, these serious questions and whether it was safe to build and operate such a reactor at the proposed site.

As pointed out by the Government in outlining the safety questions involved, (Brief, No. 454, p. 18), instability in the uranium core of the reactor may be caused by the pins of fissionable material bowing inward as the heat in the reactor rises, causing a rearrangement of the fissionable materials which would increase the rate at which neutrons were reproduced so rapidly that a nuclear runaway would occur before the reactor could be shut down. The nature of the problem is

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[8] These are not the maximum possibilities. The Introduction to that report states also "There are a few less unusual weather conditions which occur perhaps 5 per cent of the time and which could yield estimated damages outside of the range of figures estimated here. Therefore, this study does not set an upper limit for the potential damages; there is no known way at the present to do this." (Id. p. 4; Tr. 4864). H. J. Gomberg, a consultant for PRDC, in a subsequent analysis of PRDC Exhibit APDA-120 (Tr. 6163) estimated that, in the event of a complete release of fission products in an accident to a reactor of the size of the PRDC reactor, during the weather conditions mentioned, approximately 125,000 people would suffer fatal doses of radiation. (Proceedings, United Nations Second International Conference on Peaceful Uses of Atomic Energy, Vol. 11, pp. 62-63, September 1958). In the latest analysis prepared by the Oak Ridge National Laboratory for the Commission, a study was made of the potential exposure doses at the site boundaries of all present and planned nuclear power plants in the United States following the maximum credible accident for each reactor. A calculation was made for every one *except* the PRDC (Enrico Fermi) reactor because the *maximum credible accident for that reactor has not yet been* defined. (*Nuclear Safety*, September 1960, pp. 83-87).

indicated by the fact that these fuel pins are only 0.158 inches in width, the space between each pin is 0.040 inch, and a bending, or bowing, of the pins by .001 inch may have serious consequences. Inward bowing is what is deemed by the Commission to have caused a nuclear accident in 1954 at the Arco Idaho testing grounds to the only fast neutron breeder reactor which had been operated prior to the issuance of the permit for the PRDC reactor (R. 786-794). No fast breeder reactor can be deemed safe unless that problem is solved.

In this connection, it should be noted that, on or about November 1, 1960, PRDC filed with the Commission a request for modification of the construction permit, to extend the time for completion of the reactor from December 15, 1960, to December 15, 1961. In support of this request, PRDC stated, in part:

> ". . . [I]t has been necessary to redesign the fuel pin support structure in order to prevent possible unacceptable distortion of the pins. While with minor modifications the structure as first designed successfully passed proof tests in hot water, subsequent out-of-pile endurance tests in sodium at full flow and high temperature indicated that the support provided was not adequate . . ."

In other words, PRDC has not yet solved the bowing problem. The Government concedes that "Manifestly, this problem of design would have to be solved before a fast breeder reactor could be permitted to operate at the PRDC location." (Brief, No. 454, p. 18)

The Commission granted an extension of time for completing construction of the reactor to July 15, 1961.*

* A copy of the PRDC request for extension, and the Commission's order, are filed with the Clerk of this Court. However, in its *Ninth Quarterly Technical* Report to the Commission, dated March 10, 1961,

Mr. Lewis Strauss, then Chairman of the Commission, has stated that a reactor such as the PRDC reactor is "the most hazardous of all reactors" (Tr. 1146).

A substantial amount of evidence was introduced on the question of the financial qualifications of PRDC to engage in the proposed activities, and to receive an allocation of special nuclear material.

The hearing was concluded on August 7, 1957, and final briefs were filed on November 29, 1957. On December 10, 1958, the Commission issued its initial decision affirming the construction permit of August 4, 1956, and continuing it in effect with certain modifications and additions. In its principal finding on the safety issue, the Commission declared:

> "22. The Commission finds reasonable assurance in the record that a utilization facility of the general type proposed in the PRDC application and amendments thereto can be constructed and *will be able to be operated* at the location proposed without undue risk to the health and safety of the public." (R. 615). (Emphasis added).

On the financial issue, the Commission found, inter alia:

> "34. The Applicant is financially qualified to engage in the construction and *operation* of the reactor described in the application and to receive the allocation of special nuclear material therefor." (R. 618) (Emphasis added).

Respondents filed exceptions to the initial decision, including the safety findings on the proposed site (R. 939-945; Exceptions Nos. 7, 19, 21, 22, 23, 29).

The Commission denied the application by PRDC for exemption from regulations of the Commission. (R. 623; *supra*, pp. 6-7).

PRDC declared, "As stated in previous quarterly technical reports, uncertainties associated with certain developmental aspects of the plant make precise prediction of a facility completion date impossible at this time." (p. 6)

2. *Decision of the Commission*

On May 26, 1959, almost 22 months after the taking of testimony was concluded,[10] the Commission issued its Opinion and Final Decision. All exceptions taken by Respondents were dismissed (R. 699, 700).

However, the Commission changed a number of its findings in the Initial Decision, including its principal finding on the safety issue. The Final Decision contains *no finding* on the *issue specified* by the Commission itself, namely, whether there is sufficient information to provide reasonable assurance that a utilization facility of the general type proposed by PRDC can be constructed and operated at the Lagoona Beach site without undue risk to the health and safety of the public (*supra*, p. 6).

Instead, qualifying the finding it had made in its Initial Decision, the Commission found only as follows:

> "22. The Commission finds reasonable assurance in the record, *for the purposes of this provisional construction permit*, that a utilization facility of the general type proposed in the PRDC Application and amendments thereto can be constructed and operated at the location without undue risk to the health and safety of the public." (R. 708). (Emphasis added).

The Commission stated its applicable standard for construction permits, in part, as follows:

> ". . . The basic statement of the standards under which the Commission will issue both licenses and construction

[10] The decision was issued after the close of hearings on the confirmation of the appointment of Lewis L. Strauss, Chairman of the Commission, to the post of Secretary of Commerce, in the course of which his conduct in this case was severely criticized by members of Congress. The hearings closed on May 14, 1959. (Hearings before Senate Committee on Interstate and Foreign Commerce, 86th Cong., 1st Session, Nomination of Lewis L. Strauss, pp. 927, 934-935, 958-959, 1014)

permits is Section 50.40 of our regulations. Under that regulation, where a construction permit for a developmental facility is involved, the Commission must be assured that (a) the *construction* of the facility will not endanger the health and safety of the public, (b) the applicant for the permit is technically and financially qualified to engage in the proposed *construction*, and (c) the issuance of the permit for *construction* will not involve acts inimical to the common defense and security or to the health and safety of the public." (R. 643, 644) (Emphasis in original).

The Commission further emphasized the limited nature of its findings by other statements. For example, it declared:

> "It has not been positively established that a fast breeder reactor of the general type and power level proposed by Applicant can be *operated* without a credible possibility of releasing significant quantities of fission products to the environment." (R. 706) (Emphasis in original.)

Repeatedly the Commission emphasized that its findings on safety were limited to "the purposes of the provisional construction permit." (R. 676, 677, 679, 710).

On the question of the suitability of the site of the reactor, the Commission's findings are equivocal. For example, it declared:

> "Although the data (as to site suitability) are not yet complete or conclusive, the record gives reasonable assurance that safe operation of the reactor will be as likely in that location *as in any other location*" (R. 678). (Emphasis added).

But, it also declared,

> ". . . the question of safety obviously cannot be considered without regard to proposed location" (R. 677).

Although some of the Commission's findings refer to the "general type" of reactor proposed by PRDC, the Commission's opinion and findings make frequent references to the specific reactor proposed by PRDC. (R. 660, 661, 666, 673, 675, 704, 705, 710). A very substantial part of the testimony offered by PRDC related to the design and specifications of the PRDC reactor. (Tr. 1973-2117; 2127-2255; 2269-2400; 2402-2542; 2544-2683; 4121-4194; 4201-4246; 4390-4400.)

After reviewing the evidence in the record, the Commission stated (R. 676-677):

> "It is enough for the purposes of the present proceeding (that is, for the issuance of a provisional construction permit, and for the satisfaction of the requirements of the statute and the regulations, that there be reasonable assurance that *the reactor* can be constructed and operated without undue risk to the health and safety of the public." (Emphasis added).

With respect to the issue of financial qualification, the principal finding of the Commission is that, *for the purposes of a provisional construction permit*, there is reasonable assurance that the applicant is financially qualified to engage in the construction *and operation of the reactor described in the application*, and to receive the allocation of special nuclear material therefor (R. 711; No. 34). The Commission made no finding on specified issue B, namely, whether PRDC is financially qualified to engage in the *proposed activities* or to receive an allocation of special nuclear material. The proposed activities, as shown by the PRDC application, were

"to design, construct, and operate" the reactor described (R. 364, 365).

The Commission found that demonstration of the economic practicability of the fast breeder reactor would increase by many times the available reserves of nuclear fuel, and that proceeding with construction along with research and development will save time in placing the proposed reactor into operation.[11]

The PRDC brief asserts, in summarizing the decision of the Commission, that the construction permits issued for every one of the eight other developmental power reactors authorized prior to the decision of the court below were similarly provisional permits issued under the terms of Regulation 50.35. (Brief, No. 315, p. 13). The fact, however, is that *none* of those eight permits was limited to the "purposes of the provisional permit." In *all* those permits, 3 issued before the original PRDC permit, and 5 issued thereafter, as well as in all permits issued for research reactors (58 at the time of the decision of the court below) the Commission made the unqualified finding, *at the time it issued the permits*, that it had "information sufficient to provide

[11] W. Kenneth Davis, who testified during the hearing as AEC Director of Reactor Development that this was one of the most important programs of AEC, and that "the fast breeder reactor is one of the most promising types for the development of electric power on a commercially feasible basis," (R. 831), subsequently changed his mind. He later declared that emphasis on breeder reactors "could seriously delay our arriving at economically useful nuclear power . . . Since a nuclear electric power industry equal to the current total electric power production capacity is not expected for another 20 to 30 years . . . there scarcely appears to be great urgency for the development of breeders . . . (T)here might develop around 1990 or 2000 A.D. a need for breeders if the uranium production rate could not be increased or could be increased only at a large increase in costs." (*The Forum Memo to Members*, February 1959, p. 45.) In October 1960 the Office of Technical Information of the Commission issued report TID-8209, *Fossil Fuels of the future*, stating p. 2: "Thus the conclusion of this study is that fossil fuels can meet energy requirements in both the United States and the remainder of the world for the rest of the century without difficulty. . . ."

reasonable assurance that a facility of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public (*infra*, p. 102).

The Government brief, in its Statement, asserts there have been no injurious accidents in "routinely-operating" reactors, without defining which reactors are of that nature (Brief, No. 454, p. 19). It does concede, however, that a fatal accident occurred on January 3, 1961, when an experimental reactor exploded at the National Reactor Testing Station at Arco, Idaho, killing 3 people, and causing a radioactive cloud to form in the atmosphere, as well as radioiodine contamination in the surrounding area.[12] The fact is that many reactor accidents have occurred, some causing serious injuries to reactor personnel and undetermined injuries to the surrounding population. (*Infra*, pp. 105-108)

3. *Pertinent amendments to the Act after issuance of original construction permit*

As a result of vigorous criticism from various sources, including members of the Joint Committee on Atomic Energy, concerning the procedure followed by the Commission in granting the construction permit herein, (*supra*, p. 5 n.) Congress amended the Act in several respects.

Section 189 was amended to *require* the Commission to hold a hearing after 30 days notice, and publication once in the Federal Register, on each application for a license for a facility of the kind involved herein, as well as other specified facilities. This includes the issuance of construction permits. (*infra*, p. 95)[13] There was no hearing prior to the issuance of the original permit in this case.

[12] *Interim Report on SL-1 Incident*, General Manager's Board of Investigation, January 27, 1961, pp. 13-14.

[13] 42 U.S.C. § 2239; Act of September 2, 1957, 71 Stat. 579, Sec. 7; Senate Report No. 296, May 9, 1957, pp. 24, 25, to accompany S. 2051.

Furthermore, the Act was amended, in Sections 29 and 182 b, to provide for the establishment of the Advisory Committee on Reactor Safeguards (which had been created by the Commission several years earlier) with authority to review applications for reactors of the type involved herein, and to advise the Commission with regard to the hazards of proposed or existing reactor facilities and the adequacy of proposed reactor safety standards. (*infra*, pp. 91-94.) The Committee is required to issue reports on the applications submitted to it, which shall be made part of the record of the application and available to the public, except to the extent security classification prevents disclosure.[14]

In this case, the Commission refused to release the report of its Advisory Committee on Reactor Safeguards until October 8, 1956, more than 6 weeks after the Respondents had filed their petitions to intervene (*supra*, p. 3). Under the Commission's regulations in effect at the time the petitions for intervention had to be filed within 30 days after the issuance of the construction permit, that is, no later than September 3, 1956 (AEC Rules of Practice, Section 2.705, Title 10, CFR).

In its report on this amendment, the Joint Committee commented on the need for a statutory committee and for access to its reports, as follows, in part:

> "While the Atomic Energy Act of 1954 has over 18 references to health and safety requirements, there was no body specifically established in the act whose primary responsibility would be to study and advise on the health and safety aspects of licensed operations. The Joint Committee deemed it desirable to establish formally such a body as an advisory committee to assist

[14] 42 U.S.C. §§ 2039, 2232(b); Act of September 2, 1957, 71 Stat. 579, Sec. 5 and 6.

the Commission with respect to those facilities where the hazard is likely to be the greatest.

"Having established the Committee under the bill, it was thought that its functions would be best served if its reports should be made public, and if the facilities of the type on which its report were required should be licensed only after a public hearing . . .[15]

Finally, Congress amended the general appropriation authorization in Section 261 of the Act to prevent contractual commitments of government funds without prior appropriation, as was done in the PRDC case to the extent of over $4 million. That section was amended effective July 3, 1957, to require *specific* authorization, *inter alia*, for sums necessary to carry out cooperative programs for development and construction of reactors to produce electric power, and provide for the undertaking of research and development without full reimbursement, or the waiver of fuel charges.[16] The latter two provisions were included, *inter alia*, in the Commissions agreement with PRDC, which was concluded on March 26, 1957 while the hearings in this case were in progress. (Tr. 5091-5112). The Commission actually committed $100,000 to this project for *fiscal 1957*, prior to the time the agreement was executed.[17]

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[15] Senate Report No. 296, pp. 11-14, 24, 85th Cong. 1st Session. Although these amendments became effective September 2, 1957, the Commission did not refer the PRDC application to the Advisory Committee on Reactor Safeguards for any purpose any time thereafter.

[16] 42 U.S.C. § 2017(a)(2). P.L. 85-79; 71 Stat. 274. Report No. 571, June 14, 1957 to accompany H.R. 7992. The report states, in part, "The Chairman of the House Committee on Appropriations had been particularly critical of the authorization procedures and interpretations of the Atomic Energy Act followed by the AEC in previous years." See statement of Clarence Cannon, Chairman of House Committee on Appropriations, sharply criticizing AEC for violations of the Act, 103 Cong. Rec. 5790-5801, April 16, 1957.

[17] 103 Cong. Rec. 5798, April 16, 1957

4. *Decision of Court of Appeals*

Respondents petitioned the court below to review the decision of the Commission, and stated a number of issues for review (R. 951-953).

The court reversed the Commission, stating:

> "Because we think the safety findings insufficient, we must set aside the Commission's grant of a construction permit and remand the case for such further proceedings consistent with this opinion as the Commission may determine. We need not consider other points raised by the petitioners." (R. 965).

The court stated, *inter alia*,[18] that when the Commission authorizes construction of a reactor it must make a finding, as of the time the construction permit is issued, that the Commission "has reasonable assurance that the reactor may be constructed and operated at the proposed site without undue risk to the health and safety of the public." (R. 957).

After reviewing pertinent sections of the Act, particularly Sections 182 and 185, and carefully examining the relevant portions of its legislative history, the court held that when the Commission issues a construction permit, it must, in accordance with Section 182, "'find that the utilization or production of special nuclear material . . . will provide adequate protection to the health and safety of the public,' or, in the Commission's phrase, that the facility can be 'operated at the location proposed without undue risk to the health and safety of the public.'" (R. 959-960).

The court rejected the contention of the Commission

[18] One ruling of the court was that the decision of the Commission was a final order and aggrieved the Respondents here (R. 955-957). This issue is not before this Court now because it was excluded in the grant of certiorari (R. 972, 973).

that the legislative history relied on related only to "'procedural safeguards' of notice, hearings, and appeal." It declared, "We cannot so understand it and cannot suppose the Senate so understood it." (R. 959, footnote).

The court further pointed out that "The possibilities of harm are so enormous that any doubt as to what findings the Act requires, and any doubt as to whether the Commission made such findings, should be resolved on the side of safety." (R. 960)

The court held that the Commission's findings regarding safety of operation are not sufficient. It pointed out that the Initial Decision in this case, dated December 10, 1958, contains this unqualified finding: "22. The Commission finds reasonable assurance in the record that a utilization facility of the general type proposed in the PRDC application and amendments thereto can be constructed and will be able to be operated at the location proposed without undue risk to the health and safety of the public." (R. 960). But in its Opinion and Final Decision, the Commission qualified that finding as follows:

> "22. The Commission finds reasonable assurance in the record, *for the purposes of this provisional construction permit*, that a utilization facility of the general type proposed in the PRDC Application and amendments thereto can be constructed and operated at the location without undue risk to the health and safety of the public." (Emphasis in original) (R. 960-961).

The court held that this is not a finding that a facility can be operated at the location selected without undue risk. The court quoted other statements of the Commission which confirmed the conclusion that it no longer found, as it had found in its Initial Decision, reasonable assurance that a facility can be operated at the location without undue risk. (R. 961-962). The court then pointed out that the Commis-

sion also used other expressions which might seem to indicate a positive opinion regarding the safety of operation. (R. 963).

The court concluded that the Commission's findings regarding safety of operation were ambiguous, although, in view of the nature, size, and location of the project, it thought the findings should be uncommonly free from ambiguity. The court declared that the Commission should make the basis of its action reasonably clear, that it did not do so in this case, and that the court must know what a decision means before it can say whether or not it is right or wrong.

Contrary to the PRDC summary of the court's decision (Brief, No. 315, pp. 16, 17), the court below did not hold that the statute required a *definitive* and *final* determination of safety of operation as a prerequisite to issuance of any construction permit. Nor did the court, explicitly or by implication, invalidate the two-stage licensing procedure authorized by the Act.

The court also found that the Commission's safety findings were deficient with respect to the safety of the site on which the reactor is being built. The court pointed out that the Commission, after reviewing the evidence concerning the suitability of the site, stated, "Although the data of these types are not yet complete or conclusive, the record gives reasonable assurance that safe operation of the reactor will be as likely in that location as in any other location." The court declared that this finding was clearly insufficient in view of the absence of a finding that the reactor could be operated without undue risk to the health and safety of the public (R. 965).

The court stated, in the course of its site discussion, that it was clear from the Congressional concern for safety that Congress intended no reactor should, without compelling reasons, be located where it will expose so large a popula-

tion as is present in this situation to the possibility of a nuclear disaster, and that the Commission did not find compelling reasons for doing so in this case. However, it did not hold that the absence of such finding was the reason for the insufficiency of the Commission's finding on site suitability. The court's conclusion on this point was:

> "We need not consider whether even the most compelling reasons for preferring this location could support a finding that the reactor could be operated at this location without 'undue' risk, or with 'adequate' protection, to the health and safety of the public." (R. 965).

Contrary to the Government summary of the decision, (Brief, No. 454, p. 22) the court below did not hold that the safety findings were insufficient because the Commission did not specifically find that there were "compelling reasons" for locating the reactor near a heavily populated area. The PRDC summary, while less categorical, is equally erroneous in asserting that "the court rested its decision on the merits on the additional ground" that a finding of "compelling reasons" was not made. (Brief, No. 345, pp. 17, 18).

Summary of Argument

The issue before this Court is whether or not the Commission made essential safety findings at the time it issued a construction permit for the PRDC reactor. The Commission's basic finding on safety was that "The Commission finds reasonable assurance in the record, for the purposes of this provisional construction permit, that a utilization facility of the general type proposed in the PRDC application and amendments thereto can be constructed and operated at the location without undue risk to the health and safety of the public."

The issuance of a construction permit by the Commission

for a nuclear reactor, with such a finding, is a violation of the Atomic Energy Act of 1954 and the Regulations of the Commission.

Adequate protection for the health and safety of the public was a paramount consideration of the Congress when it adopted the Act. Development of atomic energy for peaceful purposes must be consistent with the health and safety of the public, and no considerations of expediency can prevail over this limitation.

I

A. The basic provisions of the Act for the purposes of this case are Sections 182 and 185. Activities by private persons requiring the use of special nuclear materials must be licensed by the Commission. Section 182 prescribes the content of applications for a license under the Act. With respect to applications for licenses to operate reactors the applicant must state technical specifications including place of use, specific characteristics of the facility, and such other information as the Commission may by regulation deem necessary to enable it to find that the reactor will provide adequate protection to the health and safety of the public.

Section 185 relates to construction permits. It provides that applicants for licenses to construct reactors shall, if the application is otherwise acceptable, be initially granted a construction permit, but this section make no specification of the content of the application.

The basic questions of statutory construction in this case are (1) whether or not the Act provides any safety standard which must be satisfied before a construction permit for a reactor may be issued; and, (2) if so, what that standard is. The first question must be answered in the affirmative. The answer to the second is that the Commission

must find, when it issues a construction permit, that operation of the reactor will provide adequate protection to the health and safety of the public.

The theory of the Act underlying the licensing of reactors is that, once a construction permit is issued, a license for the reactor will be issued if the terms of the construction permit are carried out. Section 185 states 4 conditions for obtaining a license pursuant to an application for a license to construct a reactor—namely, (1) completion of construction; (2) filing of additional information needed to bring the original application up to date; (3) a finding by the Commission that the facility has been constructed and will operate in conformity with the application, the rules of the Commission and the Act, and (4) absence of good cause being shown to the Commission that the grant of a license will not be in accordance with the provisions of the Act. If those conditions are met, the Commission is required to issue a license.

Up to this point, Section 185 makes no specific reference to standards of safety. However, the last sentence of the Section states that "For all other purposes of this Act, a construction permit is deemed to be a license." One consequence of this provision is to incorporate the substance of Section 182, on license applications, into Section 185. The requirements for licenses set forth in Section 182 become applicable to issuance of construction permits, and these include the finding of adequate protection for health and safety of the public.

B. The legislative history of the Act confirms the view that such a finding must be made by the Commission at the time a construction permit is issued. The Joint Committee on Atomic Energy, in its report on the bill that became the Act, stated that Section 185 requires the issuance of a license if construction is carried out in accordance with the

terms of the construction permit. During the course of debate on the bill in the Senate, it was agreed that Section 182 applies to construction permits.

The rationale for making such a requirement was clearly stated during Congressional debate before passage of the Act, namely, that if essential questions were not resolved at the time the construction permit was granted, and substantial expenditures were made on the basis of the permit, there would be considerable pressure on the Commission to issue the license because of such expenditures.

C. The Commission is authorized to issue regulations "to govern any activity authorized pursuant to this Act . . . in order to protect health and to minimize danger to life and property." Sec. 161i(3). Any regulations promulgated by the Commission must be consistent with the authority which has been delegated to it.

The applicable regulations of the Commission can be interpreted to fall within the Commission's delegation of authority. As heretofore applied by the Commission in other cases, they are valid. However, as interpreted and applied by the Commission in the case at bar, they are not valid.

Regulation 50.40, which the Commission terms "the basic statement of the standards" for both license and construction permits, requires that the processes to be performed, the operating procedures, the use of the facility, and other technical specifications "provide reasonable assurance . . . that the health and safety of the public will not be endangered" and that the issuance of a license "will not . . . be inimical . . . to the health and safety of the public."

On its face, this regulation is in accord with the requirements of Sections 182 and 185 as interpreted above. However, for this case, the Commission interpreted this regulation to mean that where a construction permit for a developmental facility is involved, the only safety findings re-

quired are that construction of the facility will not endanger the health and safety of the public, and that issuance of the construction permit will not involve acts inimical to the health and safety of the public. This interpretation is contrary to the Act and the plain meaning of the regulation, and is therefore invalid.

The Commission carried this error over to its interpretation of its Regulation 50.35, which states the conditions under which the Commission will issue a construction permit where the applicant is not in a position to supply initially all of the technical information otherwise required. It provides that if the Commission is satisfied that it has information sufficient to provide reasonable assurance that a facility of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public, and that the omitted information will be supplied, it may issue a construction permit.

Less than 2 months prior to issuing the original PRDC construction permit, and after it had already issued construction permits for 3 nuclear power reactors, the Commission informed the Appropriations Committees of Congress that applicants for licenses to build such reactors had to make very detailed showing of how they would protect their employees and the public from radiation hazards, and have it evaluated, before a license to build would be granted. About 2 months after the issuance of the original PRDC permit, the Commission informed the Joint Committee to the same effect stating specifically that a construction permit may be issued only if there is reasonable assurance that unresolved safety problems can be resolved in a way that will make it possible for the applicant to operate the proposed reactor at the proposed site without undue risk to the health, safety and property of the public. That practice was followed in the issuance of construction permits for all

research and development reactors, including power reactors, except the PRDC reactor.

D. The Commission failed to keep the Joint Committee fully informed in these matters, however. For a short period it sought to withhold from Congress the fact that its Advisory Committee on Reactor Safeguards had given an adverse report on the safety characteristics of the PRDC reactor. Criticism of the procedure followed in the granting of the original PRDC construction permit resulted in several amendments to the Act.

E. Petitioners do not now contend that the Commission complied with its own practice and regulations when it issued the original PRDC construction permit, on August 4, 1956, immediately after which construction began, but do contend that the amended permit issued on May 29, 1959, did comply with the Act and the Commission's regulations.

However, the amended permit was not issued in accordance with the requirements of the Act, or with the requirements of the Commission's regulations. The Commission failed to find, at the time of issuing the amended permit, that the PRDC reactor could operate with adequate protection for the health and safety of the public. This is contrary to the requirements of Sections 182 and 185 of the Act. The Commission found reasonable assurance as to safety only for the purposes of a provisional construction permit, which, in the light of its interpretation of Regulation 50.40, means safety for construction purposes only. The findings of the Commission are not in accord with the applicable regulations, if those are reasonably and validly interpreted.

In any event, the safety finding in this case does not meet the specification of the safety issue determined by the Commission at the outset of the proceeding—which calls for a finding, as a basic condition for the issuance of a construction permit, that there is information sufficient to provide

reasonable assurance that a utilization facility of the general type proposed by PRDC can be constructed and operated at the Lagoona Beach site without undue risk to the health and safety of the public.

F. The court below held that, at best, the findings of the Commission concerning safety of operation are ambiguous. On the one hand, a finding of safety "for the purposes of a provisional construction permit" and the predictions regarding the future course of scientific development, do not satisfy the requirements of the Act. On the other hand, there are a few expressions which might seem to indicate a positive opinion regarding safety of operation. However, inasmuch as the Commission failed to make the basis of its action reasonably clear, the court is not obliged to determine the validity of the Commission's decision.

II

The holding of the court below that the Commission's safety findings are insufficient is not based on the failure of the Commission to find "compelling reasons" for approving location of the PRDC reactor near a densely populated area. The court neither required a special subordinate finding of such reasons, nor made the absence of such finding an alternative ground of its decision.

After holding that the Commission's safety findings concerning the proposed reactor itself were deficient, the court held that the findings were deficient in an additional respect, namely, with regard to the site at which the reactor is being built. Although the record shows the possibility of a major disaster resulting from a reactor accident, inasmuch as more than 2 million people live within a radius of 30 miles from the site of the reactor, the Commission concluded that "the safe operation of the reactor will be as likely in that location as in any other location." This is not an adequate finding that the reactor will operate safely in the

chosen location. The Government now concedes that the proximity of the population demands a higher degree of safety, and the Commission has recently published a proposed regulation which incorporates this principle.

While the court below did state that Congress intended that no reactor should, without compelling reasons, be located near a densely populated area, the court removed this consideration from the area of decision by stating that even the most compelling reasons for locating a reactor at such a place would not be sufficient basis for a finding that a reactor could be operated there without undue risk to the health and safety of the public.

ARGUMENT

I.

THE ATOMIC ENERGY COMMISSION VIOLATED THE ATOMIC ENERGY ACT OF 1954 AND ITS OWN REGULATIONS IN GRANTING A CONSTRUCTION PERMIT FOR THE PRDC REACTOR WITH INADEQUATE SAFEY FINDINGS.

Adequate protection to the health and safety of the public was a paramount consideration of the Congress when it adopted the Act. In more than 18 separate instances the Act requires that the Commission conform its activities, and those of its licensees, to the need for protecting, and prohibiting any action inimical to, the health and safety of the public.

Thus, for example, Section 2b of the Act states a Congressional finding that:

> "In permitting the property of the United States to be used by others, *such use must be regulated* in the national interest and in order to provide for the common defense and security and *to protect the health and safety of the public.*" (Emphasis added)

Congress finds further, in Section 2d, that:

> "The processing and utilization of source, by-product, and special nuclear material *must be regulated* in the national interest and in order to provide for the common defense and security and *to protect the health and safety of the public.*" (Emphasis added)

It is one of the purposes of the Act, as stated in Section 3d, to provide for:

> "a program to encourage widespread participation in the development and utilization of atomic energy for peaceful purposes to the maximum extent *consistent* with the common defense and security and *with the health and safety of the public;*" (Emphasis added)

There is nothing in the Act, or its legislative history, that states or infers that participation in the development of atomic energy for peaceful purposes is to be allowed to the detriment of health and safety. Such activity must be "consistent with," and "must be regulated" to provide for, that objective.

But Petitioners imply that there are considerations of expediency which temper this concern for health and safety. PRDC argues that Congress recognized "the urgent need to accelerate the development of nuclear energy for peaceful purposes" and the importance of speed in such development "in order to maintain American leadership in this field," and that members of the Joint Committee "acknowledged repeatedly that the United States was engaged in a crucial race for supremacy in peacetime atomic progress" (Brief, No. 315, pp. 26, 27).

Such interests on the part of Congress or the members thereof did not dilute to any degree Congressional insistence on adequate protection of the health and safety of the public.

There is no priority provided for research and development over safety and health.[19]

A. *The Act requires a finding by the Commission at the time a construction permit is issued that the reactor will operate with adequate protection to the health and safety of the public.*

The licensing provisions of the Act draw no distinctions, so far as safety requirements are concerned, between commercial reactors and developmental reactors; that is, they draw no such distinctions between reactors whose design and practical value have been tested and proved to be of practical value, and those in the course of development.

Section 102 of the Act provides that when a facility has been sufficiently developed to be of practical value for industrial or commercial purposes the Commission may issue a license under Section 103. The latter section requires, *inter alia*, that no license may be issued thereunder if it "would be inimical to . . . the health and safety of the public."

Section 104 (b) provides, in part:

> "The Commission is authorized to issue licenses to persons applying therefor for utilization and production facilities involved in the conduct of research and development activities leading to the demonstration of the practical value of such facilities for industrial or commercial purposes. In issuing licenses under this subsection, the Commission shall impose a minimum amount of such regulations and terms of license as will permit *the Commission to fulfill its obligation* under this

[19] The report of the Advisory Committee on Reactor Safeguards stated specifically, with respect to the PRDC reactor, that the development of this reactor should not "be so bold as to risk the health and safety of the public." (R. 592-593).

chapter to promote the common defense and security and *to protect the health and safety of the public* . . ." (Emphasis added) (*infra*, p. 92)

All applications for licenses are subject to Section 182 of the Act, (*infra*, p. 93) which provides in pertinent part that:

"a. Each application for a license hereunder shall be in writing and shall specifically state such information as the Commission, by rule or regulation, may determine to be necessary to decide such of the technical and financial qualifications of the applicant, the character of the applicant, the citizenship of the applicant, or any other qualifications of the applicant as the Commission may deem appropriate for the license. In connection with applications for licenses to operate production or utilization facilities, the applicant shall state such technical specifications, including information of the amount, kind and source of special nuclear material required, *the place of the use, the specific characteristics of the facility, and such other information as the Commission may, by rule or regulation, deem necessary in order to enable it to find that the utilization or production of special nuclear material* will be in accord with the common defense and security and *will provide adequate protection to the health and safety of the public*. Such technical specifications shall be part of any license issued. The Commission may at any time after the filing of the original application, and before the expiration of the license, require further written statements in order to enable the Commission to determine whether the application should be granted or denied or whether a license should be modified or revoked . . ."

The reference in that section to the "license to operate production or utilization facilities" applies to the informa-

tion required in the original applications for reactors, under Sections 103 and 104, as distinguished from the information required by the Act for other activities that must be licensed.[20] It is not intended to distinguish operation from construction, for the information required is the kind needed to describe the facility which is to be constructed, namely technical specifications, the location of the facility, etc. PRDC so understood it, for its application for a construction permit included an application for a license to operate the reactor it would build (R. 364, 368, 379, 380).

It is patently absurd to argue, for example, as the Petitioners must in order to sustain their position, that the requirement of Section 182 for information from the applicant as to *place of use* of nuclear materials applies *for the first time* when permission to operate is sought, that is, after construction of the reactor where that nuclear material is to be used.

It should be noted that Section 182 does not mention, generally or specifically, reactors of a "general type" as distinguished from a particular reactor. On the contrary, this Section requires that the license application state the technical specifications "including the specific characteristics of the facility." There is no reference in any provision of the Act to licenses for "general types" of reactors.

Section 185 relates to licenses to construct reactors:

> "Construction Permits. All applicants for *licenses to construct* or modify production or utilization facilities shall, if the application is otherwise acceptable to the Commission, be initially granted a construction permit. The construction permit shall state the earliest and

[20] These include conduct of research and development activities relating to nuclear processes, use of nuclear and radioactive material for medical, biological, industrial, agricultural, health and military purposes, and for such other uses as the Commission may determine to be appropriate to carry out the purposes of the Act (42 U.S.C. §§ 2051, 2073, 2092, 2093).

latest dates for the completion of the construction or modification. Unless the construction or modification of the facility is completed by the completion date, the construction permit shall expire, and all rights thereunder be forfeited, unless upon good cause shown, the Commission extends the completion date. Upon the completion of the construction or modification of the facility, upon the filing of any additional information needed to bring the original application up to date, and upon finding that the facility authorized has been constructed and will operate in conformity with the application as amended and in conformity with the provisions of this chapter and of the rules and regulations of the Commission, and in the absence of any good cause being shown to the Commission why the granting of a license would not be in accordance with the provisions of this Act, the *Commission shall thereupon issue a license to the applicant. For all other purposes of this Act a construction permit is deemed to be a 'license'*". (Emphasis added).

It is evident that this Section is merely a supplement to Section 182 with respect to license applications. It makes no reference to any information required in the original application. The section specifies certain conditions for obtaining a license, not a license to operate.[21] These conditions are (1) completion of the construction; (2) filing of additional information needed to bring the original application up to date; (3) a finding that the facility has been constructed and will operate in conformity with the application, the rules of the Commission and the Act; and (4) absence of good cause being shown to the Commission that the grant of a license will not be in accordance with the provisions of

[21] Both the Government and PRDC occasionally read in the words "license to operate" where the Act says only "license". (Brief, No. 154, pp. 23-26, 37; Brief No. 315, p. 29).

the Act. The section concludes with the provision that for all other purposes, *a construction permit is deemed to be a license*.

In other words, this section provides that if the conditions of the construction permit and the requirements of the law are met, *a license will be issued* on completion of construction.

It should be noted that this section,—on which Petitioners raise their entire superstructure of argument rationalizing different standards for construction permits and operating licenses—does not contain a single reference to a license to operate. Its opening provision is that "*applicants for licenses to construct*" reactors "shall . . . be *initially* granted a construction permit," and then, if all the stated conditions are fulfilled, "the Commission *shall* thereupon issue a *license* to the applicant." It is apparent that the issuance of a license is the culmination of the application for a "license to construct," which phrase was used by Congress to comprehend both construction and operation. Save for the specific exceptions provided in this Section, there is no statutory authorization for distinguishing between construction and operation. In other words, for all other purposes, the phrase used by the Commission in its regulations—construct and operate—is not severable.

The Commission construes this section to mean that it provides no statutory safety standard. The Commission asserts that its rules are designed to provide for Commission determination of the form and scope of a construction permit preliminary to a Section 104 license *as appropriate in a particular case*, depending upon the particular state of research and development currently available to the proposed project. (R. 642, 643). In other words, the Commission infers it has uncontrolled discretion as to the terms of a construction permit.

The Government's brief is more explicit on this point. It

declares, "The absence of specific standards governing the grant of construction permits was evidently designed to give the Commission the *broadest discretion* in formulating appropriate safety standards at this stage of the proceeding." (Brief, No. 454, p. 50) (emphasis added).

Such an interpretation is completely untenable. It is inconceivable that, preoccupied as Congress was with the problem of protecting health and safety, it would have intended that there be no statutory safety standard for, and no limit on the Commission's discretion in regard to, the issuance of construction permits. If that were in fact its intention, the delegation of authority to issue such permits would be invalid.

Even when Congress fails to specify standards in a delegation of authority, this Court will not impute to it a purpose to give unbridled discretion. *Kent* v. *Dulles*, 357 U.S. 116, 128, 129; when the power of Congress is delegated, "the standards must be adequate to pass scrutiny by the accepted tests." (p. 129). Cf. *Panama Refining Co.* v. *Ryan*, 293 U.S. 388, 420-430; *Cantwell* v. *Connecticut*, 310 U.S. 296, 307; *Nemotko* v. *Maryland*, 340 U.S. 268, 271-273.

The PRDC position is ambiguous. On the one hand, it does not claim there are no safety standards prescribed by Section 185. Instead, it asserts that the provisions of that Section "on their face call for rather than forbid the type of regulatory structure erected on them by the Commission in Section 50.35 of its regulations." (Brief, No. 315, p. 34). Respondents submit there is nothing on the face of those provisions justifying that statement. The statement reveals, however, that PRDC recognizes that a statutory safety standard must be found. PRDC also asserts, nevertheless, that "the question of the safety of this reactor is not presented at all at this stage of the proceedings." (Brief, No. 315, p. 22). This appears to mean that no safety de-

terminations need be made when a construction permit is issued.

The only interpretation that comprehends both the language of the Act and the purposes of Congress is that Section 182 applies to construction permits as well as licenses to operate. This is emphasized beyond peradventure of doubt by the last sentence of Section 185 providing that "For all other purposes of this Act, a construction permit is deemed to be a 'license'". It is Section 182, therefore, which prescribes the safety standard. The standard is that the information specified by that Section for reactor applications is required "in order to enable (the Commission) to find that the *utilization or production* of special nuclear material will . . . provide adequate protection to the health and safety of the public." In the absence of such a finding, a construction permit cannot be issued. Utilization or production of special nuclear material requires, of course, *operation* of a nuclear reactor.

It is urged by Petitioners that Section 185 authorizes a two step procedure, (1) construction permit, (2) operating license, and that the safety determination need not be made until the operating license is to be issued. This interpretation distorts the plain meaning of the words. The purpose of the second step is to determine primarily whether or not the terms of the construction permit have been complied with.

The conditions precedent to the issuance of a license do not contemplate postponing the crucial safety findings to the second step. The first is completion of construction, which is self-explanatory. The second is filing of additional information needed to bring the original application *up to date*. Bringing information up to date cannot reasonably be construed to mean supplying essential information for the first time, as Petitioners appear to construe it. It comprehends informing the Commission of *changes* in the

information previously supplied. The third condition is that the Commission find that the facility authorized has been constructed and will operate *in conformity with the application* as amended, and in conformity with the Act and the regulations of the Commission. The finding required means, in effect, that the *terms of the construction permit have been carried out*

It is the 4th condition on which the Petitioners place their main reliance. They urge that the clause "in the absence of good cause being shown to the Commission why the granting of a license would not be in accordance with the provisions of this Act" is intended to assure that the statutory criteria for safe operation would be met before operation is permitted (Brief, No. 454, p. 50). This interpretation completely inverts the statutory language. It indicates that the Commission must on its own initiative make an independent investigation and determination, for the first time after completion of construction, that the reactor will operate safely. The Government goes so far as to say that this condition requires "*a showing . . . of the absence* of 'good cause' why the license should not issue." (Brief No. 454, pp. 56, 57). This is indeed an argument *in extremis!*

On the contrary, this clause does not contemplate that the Commission shall take the initiative. The good cause for not granting the license must be shown *to* the Commission. If the previous 3 conditions are met, and no one appears to show cause to the contrary to the Commission, the Commission *shall* thereupon issue a license to the applicant. Issuance of the license becomes mandatory. This condition does not place the burden on the Commission, or on the applicant, to show that the reactor will operate safely. The burden is on some objector to establish that the reactor does not provide adequate protection to the health and safety of the public. It provides a safeguard in the event the Commission has failed to perform its duties "in

accordance with the *provisions of the Act.*" This phraseology emphasizes the difference from the third condition, which requires "conformity with the provisions of this Act and the rules and regulations of the Commission," whereas the fourth condition omits reference to the rules and regulations of the Commission. This deliberate omission gives further indication that the Commission does not have statutory authority to interpose its rules and regulations as the basis of "good cause" for denying permission to operate a reactor.[22]

The foregoing, Respondents submit, is the proper interpretation of the "good cause" condition, and clearly exposes the untenability of the argument that Congress intended to rely on such frail machinery to achieve its safety objective. It is not conceivable that Congress, intent as it was to protect the health and safety of the public from the hazards of radiation, and having made that an explicit condition a score of times in the Act, would at this critical juncture have obscured the intention ascribed to it by Petitioners by referring merely to the "Act", and referring to regulations which the Commission might, or might not, adopt. (Brief, No. 454, pp. 50, 55, 56; Brief, No. 315, p. 34).

They give the "good cause" clause a significance wholly unwarranted by the context. The broadness of the statutory language does not permit the tearing of words out of

[22] The Government calls attention to the language of Section 319(c) of the Communications Act, 47 U.S.C. 319(c) providing that an operating license shall be issued to the holder of a construction permit unless a "cause or circumstance arising or coming to the knowledge of the Commission since granting of the permit would . . . make the operation of such station against the public interest." The Government concedes that "under that provision, an application for a permit is 'in substance' an application for an operating license." (Brief, No. 454, p. 56) That language is certainly no more restrictive than the clause "in the absence of any good cause being shown to the Commission why the granting of a license would not be in accordance with the provisions of the Act," and is, in fact, less so. There is no such difference between the respective clauses as to show any Congressional intent to apply different standards.

context (*Chatwin* v. *U.S.*, 326 U.S. 455, 463-464); "in expounding a statute, we must not be guided by a single sentence or member of a sentence." (*Mastro Plastics Corp.* v. *NLRB*, 360 U.S. 270, 285.

Finally, there is no language in Section 182 or 185, or any other Section of the Act, which expressly or inferentially authorizes so-called provisional findings of safety as a condition for issuing construction permits.

B. *The legislative history of the Act confirms the view that the Commission must make, at the time the construction permit is issued, a finding that the reactor can operate with adequate protection to the health and safety of the public.*

It is instructive to consider, first, some of the statements made during the course of the Congressional hearings on the bill that later became the Act. Mr. Paul W. McQuillen, chairman of the group which initiated the PRDC project (Dow Chemical-Detroit Edison Associates), expressed the opinion that people who were going to invest money would want the assurance that when they had the facility built in accordance with the requirements of the permit, they would be able to operate it. Mr. Cole, Chairman of the Joint Committee, asserted that under the pending bill that would be the case.[23]

[23] "Representative Hinshaw: *One of the reasons why a construction permit is desired*, I presumed, would be to make sure that the place in which the construction was to take place was a safe one from the public standpoint, that is that *it would be in a locality or a location that would be entirely safe*, and also that the facilities in connection with the construction would be such that *deleterious effects would not be had from the products that escape through flues and stacks and so forth, and pollution of streams and so on*. Is that not true?

"Mr. McQuillen: Undoubtedly.

"Representative Hinshaw: Then a license to build or acquire a production facility, if this is to be a use of Government material, which the

All witnesses who addressed themselves to this point took the same position.[24]

The Joint Committee itself was of the same mind. In its report on the bill it stated:

> "Section 185 . . . *requires* the issuance of a license if the construction is carried out in accordance with the terms of the construction permit." (Emphasis added) (1 Leg. Hist. 997, H. R. Rept. No. 2181, p. 28, 83rd Cong. 2d. Session)

This interpretation was emphasized during the course of debate in the Senate, when Senator Hickenlooper, manager of the bill, asserted, in response to a statement by Senator Humphrey, that a construction permit is equivalent to a

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bill is entirely based upon, is another factor that should enter it, should it not?

"Mr. McQuillen: Yes, sir. I think the difference in the point of view is perhaps really very slight. The Act has quite thoroughly picked up all the different points of material import to the construction and operation of a large facility in each section or chapter as it went along. A man undertaking to go into the business, of course, thinks of everything that he is going to need in order to set himself up in business. If they were all passed on together, he would have one set of conditions with the assurance of a right to operate at the end of it . . .

"I think there might be 9 conditions of one license all laid out in advance. So once that had been determined, then the people who were going to invest the money and do the construction would be able to go ahead. All they would have to do would be the same as a building meeting an architect's specifications, they would have to tick off their accomplishment against the specifications that had been laid down, but they would have the assurance that when the building was finished it would be paid for. *In this case they would have the assurance that when they had the facility finished in accordance with each of their requirements they would be able to run it.* . . .

"Chairman Cole: Would you mind my interruption. *Why cannot that be done under the terms of the bill as it is now?*

"Mr. McQuillen: I think it undoubtedly would be so operated.

"Chairman Cole: *Of course it would.*" (Hearings before Joint Committee on Atomic Energy on S. 3323 and H.R. 8862, 83rd Cong., 2d Sess., pp. 119-120; 2 Leg. Hist. 1752, 1753) (Emphasis added).

[24] Ibid., pp. 227, 417; 2 Leg. Hist. 1860, 2051.

license. Senator Humphrey had introduced an amendment to Section 185 providing that:

> ". . . No construction permit shall be issued by the Commission until after the completion of the procedures established by Section 182 for the consideration of applications for licenses under this Act.". (100 Cong. Rec. 12014, 3 Leg. Hist. 3759)

Senator Humphrey then had the following colloquy with Senator Hickenlooper:

> "Mr. Humphrey: Mr. President, at the time I drew up this amendment I was not aware of the modifications which had been made to Section 182 and also to the judicial review section, which later I discussed with the Chairman of the Committee. The purpose of the amendment when it was prepared was to make sure that the construction of a facility was not permitted prior to the authorization of a license, because *had that been done what it would have amounted to would be getting an investment of a substantial amount of capital, which surely would have been prejudicial in terms of the Commission issuing a license: In other words, if the Commission had granted the construction permit for some form of nuclear reactor, and then the question of a license was not fully resolved, surely there would have been considerable pressure, and justifiably so, for the Commission to have authorized the license once it had authorized the permit for construction.*
>
> "The Chairman of the Committee tells me he has modified the Committee amendments to the bill, of which at that time I was not aware. *The Chairman indicates to me that under the terms of the bill as amended, the construction permit is equivalent to a license.* In other words, as I understand, *under the bill a construction permit cannot be interpreted in any other*

way than being equal to or part of the licensing procedure. Is that correct?

"Mr. Hickenlooper: *The Senator is correct.* The staff has worked on this matter. An amendment was offered on, I believe, July 16, to Section 189, having to do with hearings or judicial review, and that section was tied up with other sections of the bill. *A license and a construction permit are equivalent.* They are the same thing, and one cannot operate until the other is granted.

"*The same is true with reference to hearings.* Therefore, we believe, and we assure the Senator, that the *amendment is not essential to the problem which he is attempting to reach* . . .

"Mr. Humphrey: In other words, the revised sections on judicial review and on hearings and on *revised Section 182 on license application all apply directly to construction permits.*

"Mr. Hickenlooper: *Yes.*

"Mr. Humphrey: *With that statement Mr. President I withdraw my amendment. The only purpose of the amendment was to clarify that section.* I am grateful to the Chairman for having done it before the amendment was considered." (100 Cong. Rec. 12914, 3 Leg. Hist. 3759-60) (Emphasis added).

In highly strained efforts to obviate the impact of this history, the Petitioners seek to establish that the plain import of the language of Senator Humphrey and the response of Senator Hickenlooper should be disregarded, and that emphasis should be placed on unrelated portions of the legislative history concerning proposals of a different nature. Their contention that the colloquy related merely to procedural safeguards of notice, hearings, and appeal distorts the obvious purport of the discussion.

Humphrey was very explicit that his proposed amend-

ment was intended to make sure that the "construction of a facility was not permitted prior to the authorization of a license" because if a construction permit were granted before the question of a license was resolved "there would have been considerable pressure, and justifiably so, for the Commission to have authorized the license once it had authorized the permit for construction" because of the "investment of a substantial amount of capital" for construction.[25]

The proposed amendment, and the reasons behind it, were not procedural. Senator Humphrey did not discuss procedure. It was a substantive matter, and Senator Hickenlooper recognized this when he stated that Senator Humphrey's proposed amendment "is not essential to the problem which he is attempting to reach." He explicitly distinguished this matter from the question of hearings by stating, "The same is true with reference to hearings."

Furthermore, Humphrey's statement, with Hickenlooper's agreement, that Section 182 applies "directly to construction permits" confirms the conclusion that the safety standard set forth in that Section applies to construction permits. Representative Hinshaw, member of the Joint Committee, made it clear that one of the reasons a construction permit was desired was to *make sure* that the location of the reactor "would be entirely safe," and that "deleterious effects would not be had from the products that escape through flues and stacks and so forth, and pollution of streams and so on (*supra*, p. 39 n.)

The court below drew the proper conclusion from this history that "If, as this indicates, Section 182 applies 'directly to' construction permits, when the Commission issues a construction permit it must 'find that the utilization or production of special nuclear material . . . will provide

[25] Senator Jackson argued to the same effect. 100 Cong. Rec. 11157, 3 Leg. Hist. 3528.

adequate protection to the health and safety of the public', or, in the Commission's phrase that the facility can be 'operated at the location proposed without undue risk to the health and safety of the public.'" (R. 959, 960)

PRDC does attempt a rationalization of Humphrey's remarks which results in a complete distortion. PRDC contends that his reference to pressure relates to a *particular type of reactor*, namely commercial reactors. An applicant, it says, could genuinely be misled into making a commercial investment in reliance on a construction permit, and might bring pressure on the Commission to issue an operating license to the detriment of a competing applicant (Brief, No. 315, p. 44).

Three short comments should suffice to dispose of this attempt. First, the colloquy quoted above, in its context, did not make the remotest reference to commercial reactors. Second, PRDC thus inferentially admits the validity of Humphrey's stated reason, for if pressure may be brought to obtain an operating license for a commercial reactor, it is at least as likely that pressure will be exerted to obtain an operating license for a developmental reactor, the cost of which is likely to be at least as monumental as that of the former. Third, as shown below, the Commission recognizes no distinction in requirements for technical information and safety between a commercial reactor and a developmental reactor.

The entire argument of PRDC, seeking to establish that only procedural problems were involved, piles one hypothesis on another in an effort to tie together unrelated strands of legislative history, while studiously avoiding the natural meaning of the words used in the colloquy between Humphrey and Hickenlooper. Finally, however, PRDC appears to recognize the futility of its effort by urging, after all, that the legislative history is not helpful in solving the problem in this case. (Brief, No. 315, p. 47)

C. The Act does not authorize the interpretation given by the Commission in this case to Regulation 50.35

Section 161 of the Act authorizes the Commission to:

> "i. prescribe such regulations or orders as it may deem necessary . . . (3) *to govern any activity authorized pursuant to this Act*, including standards and restrictions governing the design, location, and operation of facilities used in the conduct of such activity, *in order to protect health and to minimize danger to life or property . . .*" (Emphasis added)

At the time the Final Decision in this case was issued, the Commission had not issued any regulations or standards governing the design and location of power reactors, and there are none in effect today.

The applicable Commission regulations are of a very general nature. All applications for reactors, whether developmental or commercial, are subject to the same basic regulations. The regulations do not—any more than the Act does—provide any special consideration for developmental reactors from the point of view of the safety findings required.

Section 50.40 of the Commission's regulations (10 CFR, 50.40, *infra*, p. 98) which the Commission describes as "the basic statement of the standards under which the Commission will issue both licenses and construction permits" (R. 643), provides:

> "Common standards. In determining that a license will be issued to an applicant, the Commission will be guided by the following considerations:
>
> "(a) The processes to be performed, the operating procedures, the facility and equipment, use of the facility, and other technical specifications, or the pro-

posals in regard to any of the foregoing collectively, provide reasonable assurance that the applicant will comply with the regulations in this chapter, including the regulations in Part 20, and that the health and safety of the public will not be endangered.

"(b) The applicant is technically and financially qualified to engage in the proposed activities in accordance with the regulations of this chapter.

"(c) The issuance of a license to the applicant will not, in the opinion of the Commission, be inimical to the common defense and security or to the health and safety of the public."

Under this regulation the Commission must consider, *inter alia*, (1) the processes to be performed, (2) the operating procedures, and (3) use of the facility, and whether these endanger the health and safety of the public. These are matters which relate to *operation* of a facility, not to its construction, and are some of the matters to be considered in determining if the issuance of the license will "be inimical . . . to the health and safety of the public." Since this regulation applies to construction permits, it is clear that safety of operation must be considered in connection with the issuance of construction permits.

Recognizing, apparently, that the PRDC permit was issued in violation of this regulation, the Commission sought to interpret it to meet the exigencies of its position. It declared, in its Final Decision, that:

"Under that regulation, *where a construction permit for a developmental facility is involved*, [Emphasis added] the Commission must be assured that (a) the *construction* of the facility will not endanger the health and safety of the public, (b) the applicant for the permit is technically and financially qualified to engage in the proposed *construction*, and (c) the issuance of the

permit for *construction* will not involve acts inimical to the common defense and security or to the health and safety of the public." (Emphasis in original, except as indicated) (R. 644).

This is a patent distortion. There is no reference in the regulation to "construction permit for a developmental facility," and there is no basis for reading the word "construction" into it as indicated. There is no provision in the Act, or in any other part of the Commission's regulations, which requires applicants to supply information relating to safety of construction. Furthermore, it is difficult to conceive how the construction of the housing of a reactor can involve acts inimical to the common defense and security of the United States. It is evident that this is a tongue-in-cheek interpretation because none of the construction permits issued in this case, the original permit (R. 516-523), amended permit dated December 10, 1958 (R. 607-629; 918-938), and the amended permit dated May 26, 1959, (R. 630-720) contained any finding concerning, or even any intimation that the Commission had considered, the hazards of construction as such. The fact that the Respondents made no contention that such hazards existed would not have relieved the Commission of the necessity of making the findings if Regulation 50.40 did, in fact, require them. The only comment on this matter made by the Commission was that the Respondents had admitted that there were no hazards during construction save those usually associated with heavy construction (R. 648).

PRDC makes no effort to defend the Commission's interpretation of this regulation and fails even to mention it. The Government likewise makes no defense or explanation.

The artificiality of this interpretation is highlighted by the fact that neither the Act, nor the Commission's regulations, *require* a construction permit for the building of a

reactor, up to the point special nuclear materials are used. Section 101 of the Act requires a license "to transfer or receive in interstate commerce, manufacture, produce, transfer, acquire, possess, use, import or export any utilization or production facility." There is no reference to construction. One private research reactor was built without a construction permit, and a license was not applied for until the construction was completed. On September 4, 1958, the Commission issued a construction permit to Babcock & Wilcox Co. in which it found that the applicant had "submitted sufficient information to provide reasonable assurance that the reactor can be constructed and operated at the proposed location without undue risk to the health and safety of the public," and specified that the earliest completion date was the same day, September 4, 1958. A license to operate was issued *on the following day*. (*Babcock & Wilcox Co.*, CPRR 28, 23 F.R. 6780) This was in accord with the Act, inasmuch as after the "license to construct" was filed, a construction permit was "initially granted" in which a finding of reasonable assurance of safety of operation *of the reactor* was made, after which the Commission did "thereupon issue a license to the applicant." (Sec. 185)

The position of Respondents is supported by Regulation 50.34 (10 CFR 50.34, *infra*, pp. 96-97) which sets forth the requirements for technical information in all applications for reactors. It requires, *inter alia*, a sufficiently detailed description of all technical aspects and operating processes to permit (1) "evaluation of the radioactive hazards involved," (2) "evaluation of the adequacy of the various means proposed to minimize the probability of danger from radioactivity to persons both on and off-site"; (3) "evaluating the existence and effectiveness of safeguards against radioactive hazards in the operation of the facility," etc. These are all matters relating to *operation*. There is noth-

ing, either in this regulation or any other regulation of the Commission, requiring information from an applicant relating to the safety of *construction* of a reactor. It is evident the Commission did not believe such finding was required.

The regulation to which most attention has been directed is 50.35 (10 CFR 50.35, *infra*, pp. 97-98). This is titled "Extended time for providing technical information," and provides:

> "Extended time for providing technical information. Where, because of the nature of a proposed project, an applicant is not in a position to supply initially all of the technical information otherwise required to complete the application, he shall indicate the reasons, the items or kind of information omitted, and the approximate times when such data will be produced. *If the Commission is satisfied that it has information sufficient to provide reasonable assurance that a facility of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public*, and that the omitted information will be supplied, *it may process the application and issue a construction permit on a provisional basis* without the omitted information subject to its later production, and an evaluation by the Commission that the final design provides reasonable assurance that the health and safety of the public will not be endangered." (Emphasis added)

This regulation is intended to provide for situations in which all of the necessary technical information is not submitted in the application. Under it, the Commission may allow the applicant additional time, and issue a construction permit before getting the information, *only if* the Commission is *satisfied* it *has* information sufficient to provide *reasonable assurance* that a facility of the general type pro

posed can be constructed and *operated* at the proposed location without undue risk to the health and safety of the public. Respondents submit that this is the only reasonable conclusion to be drawn from that language.

The phrase "without undue risk to the health and safety of the public" is equivalent to the statutory requirement of "adequate protection to the health and safety of the public" (Section 182a, *infra*, p. 93). The court below so concluded (R. 958), and none of the parties has raised any question on that score.

Petitioners lay great stress on the fact that Regulation 50.35 requires an initial finding of safety only with respect to the "general type proposed," and argue that this is substantially different from a requirement of a safety finding for "the reactor" proposed. Respondents submit that this is a verbal distinction emphasized for the purposes of this case, and that the Commission issues its construction permits, in fact, for the particular reactor proposed by an applicant.

In the first place, PRDC did not apply for a license merely to construct a general type of reactor. It proposed "to build, own, and *operate* a developmental fast neutron breeder reactor which will produce the heat energy required to generate 100,000 kw. electric power" (R. 364) (Emphasis added), the design of which was described *in detail* in the application (R. 371, 372; Tr. 5197-5202). The report of the Advisory Committee on Reactor Safeguards related to the specific reactor proposed by PRDC (R. 587-593).

The original construction permit contained the following authorization for construction (R. 519):

> "The general type of facility authorized for construction is a fast neutron breeder reactor, more fully described in Report APDA-108, designed to operate at

> 300,000 KW equivalent of thermal energy and furnish approximately 100,000 kilowatts of electrical energy, and which will use uranium enriched in the isotope uranium 235 as fuel."

Although the phrase "general type" is used, it is apparent that the Commission was authorizing construction of the reactor described in detail to Report APDA 108, which was part of the PRDC application. The same authorization was contained in the construction permit as amended on May 26, 1959 (R. 716).

After the original construction permit was issued, without a finding of safety of operation, the Commission advised the Joint Committee on October 1, 1956 that under its practice and regulations it may issue a construction permit *after* "it believes there is reasonable assurance that the unresolved safety problems can be resolved in a way that will make it possible for the applicant *to operate the proposed reactor* at the proposed site without undue risk to the health, safety, and property of the public."[2]

The Opinion and Final Decision of the Commission clearly reveals that its action was taken with respect to the particular reactor proposed. Although most discussion is made in occasional references to the "type" of reactor proposed, the burden of the opinion relates to the specific reactor. Thus, it goes into considerable detail on the PRDC design (R. 666 ff.) and the "safety of the proposed reactor" (R. 669 ff.). It discusses "the spectrum of expert testimony on the safety of the proposed PRDC design" (R. 672), and states that witnesses for PRDC testified that

[2] *A Study of AEC Procedures and Organization in the Licensing of Reactor Facilities*, Joint Committee on Atomic Energy, 85th Cong., 1st Session (Joint Committee Print 1957), p. 197.

"the specific reactor proposed could be safely operated" (R. 673-676).

The Commission then concludes (R. 676, 677):

> "It is enough for the purposes of the present proceeding (that is, *for the issuance of a provisional construction permit*), and for the satisfaction of the requirements of the statute and the regulations that there be reasonable assurance that *the reactor* can be constructed and *operated* without undue risk to the health and safety of the public." (Emphasis added)

In addition, the Commission made specific findings with reference to the reactor proposed (financial qualifications, R. 685, 708; construction and design, Findings 10, 12, 13, 21, 29, R. 704, 710; operation, Findings 14, 21, R. 704, 708).

The Commission has not, indeed, even made a clear statement of what it means by "general type" or "type." It made several references to fast breeder neutron reactors known as EBR-I, EBR-II and Dounreay (R. 702-706) but nevertheless stated that none of them is a "direct prototype of the PRDC reactor" (R. 703). It is therefore not clear what a finding concerning a general type means.

In short, since the Act makes no provision for safety findings for "general types" of reactors, and since the Commission in fact makes its determinations with respect to the particular reactor proposed, the safety finding which is a condition precedent to the issuance of a construction permit must relate to the specific reactor proposed. This was confirmed by the Commission's statement in its Final Decision that it is enough "for the satisfaction of the requirements of the statute and the regulations that there be reasonable assurance that *the reactor* can be constructed and operated without undue risk to the health and safety of the public." (R. 676-677)

Finally, the Commission regulations include a provision which substantially contradicts the labored interpretations made by the Petitioners here and the Commission in its Final Decision. Regulation 50.56 (10 C.F.R. 50.56; *infra*, pp. 98-99) provides as follows:

> "Conversion of construction permit to license or amendment of license. Upon completion of the construction or alteration of a facility, in compliance with the terms and conditions of the construction permit and subject to any necessary testing of the facility for health or safety purposes, the Commission *will*, in the absence of good cause shown to the contrary issue a license of the class for which the construction permit was issued or an appropriate amendment of the license, as the case may be." (Emphasis added)

This regulation clearly places the primary emphasis on completion of construction, in compliance with the terms and conditions of the construction permit, and a determination to that effect, as the basis for a license, the issuance of which would appear, from this regulation, to be almost automatic. Petitioners completely ignore this regulation.

1. *Proposed amendment of Regulation 50.35.* Shortly after its Final Decision in this case, the Commission advised the Joint Committee that Regulation 50.35 does require a finding, at the time the construction permit is issued, that there is reasonable assurance of safe operation. On February 11, 1960, the Commission published a notice of proposed rule-making, providing an amendment of Regulation 50.35. (25 Fed. Reg. 1224; *infra*, pp. 100-101) The principal purpose of the amendment was to eliminate the requirement for a finding of safety of operation at the time a construction permit is issued, and to authorize

issuance of a construction permit with no approval required save for that of the site. The matter came before the Joint Committee, and the Commission spokesman gave the following explanation:

> "Under current regulations the critieria for the issuance of a construction permit, briefly stated, are, first, a reasonable assurance that the facility of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public.
>
> "You will note there is an inference in the current regulation, and *there is an indication that the problems involved in safely operating the facility can be adequately reviewed and taken into account at the time the construction permit is issued.* Experience has indicated that is asking both the applicant, the Commission, and for that matter, the ACRS, to go farther than technology actually permits at this time.
>
> "So the criteria in the proposed regulation is reasonable assurance that the proposed location is suitable from a safety standpoint for a facility of the size and general design concept proposed."[27] (Emphasis added)

Respondents submit that this explanation substantially nullifies the elaborate rationalizations in which the Petitioners engage in their briefs to this Court.

The fact that its administration of the Act persuaded the Commission that its previous interpretation is not prac-

[27] Hearings on Development, Growth and State of the Atomic Energy Industry before the Joint Committee on Atomic Energy, 86th Congress 2nd Session, pp. 103-105, February 17, 1960. Senator Anderson, then Chairman of the Joint Committee, was highly critical of the proposed amendment (Id. pp. 105-109).

ticable does not validate a proposal that is not authorized by the Act. "Administration may reveal gaps or inadequacies of one sort or another that may call for amendatory legislation. But it is no warrant for extending a statute that experience may disclose should have been made more comprehensive". *Addison v Holly Hill Fruit Products, Inc.* 322 U.S. 607, 617.

The proposed amendment was abandoned after the decision of the court below was issued. However, this matter arose again before the Joint Committee recently, and Mr. Olsen, member of the Commission, who was its general counsel when the Final Decision in the PRDC case was issued, made the following statement concerning construction permits, in response to questions by Senator Anderson on an application for a reactor to be located at Peach Bottom, Pennsylvania:

> "We are still operating under the original rule which requires that a finding be made that there is reasonable assurance, in effect, that this research program will be successful. We are pre-gauging the research program."[28]

The colloquy between Mr. Olsen and Senator Anderson, the significant part of which is reprinted in the margin, indicates a concession by Mr. Olsen that the original rule was not followed in the PRDC case.[29]

[28] Hearings on Development, Growth, and State of the Atomic Energy Industry, 87th Cong. 1st Session, p. 73 official transcript. February 21, 1961.

[29] "Senator Anderson. You say, 'I would like to point out that such considerations not involved in the question of the site itself are likely to result in a considerable delay in the high temperature gas reactor project proposed for construction at Peach Bottom, Pennsylvania.'

"I assume by that you do anticipate some delay?

"Mr. Wilson (AEC Commissioner). Yes, we do.

"Senator Anderson. Therefore, you are proceeding in this case *the*

The Respondents submit, in the light of the foregoing, that the Commission's regulations require a finding, at the time the construction permit is issued, that the proposed reactor can be operated with adequate protection—without undue risk—to the health and safety of the public. To interpret them otherwise is to render them invalid.

The regulations promulgated by the Commission must be consistent with the Act. Otherwise, the regulations are not authorized by the statute, and are invalid. *Kent* v. *Dulles*, 357 U.S. 116; *Brannan* v. *Stark*, 342 U.S. 451; *Addison* v. *Holly Hill* [illegible], 322 U.S. 607; *Manhattan General Equipment Co.* v. *C.I.R.*, 297 U.S. 129, 134.

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way we tried to get the Commission to proceed in the Fermi (PRDC) reactor case.

"Mr. Wilson. We have substantially changed our regulatory procedure. I think Mr. Olson might better reply to that.

"Senator Anderson. You tried to change it a year ago, Mr. Olson and didn't get away with—didn't succeed with it.

"Mr. Olson. I don't think we tried to get away with something. We have not put in effect the rule that was up for consideration at that time.

"Senator Anderson. You submitted some regulations. Was any warning given us that if those regulations had been adopted you could do in the Fermi case and in the Peach Bottom case exactly what they tried to do in the Fermi case?

"Mr. Olson. Mr. Anderson, you are a very hard lawyer to operate against because you see a lot of things that we don't seem to see. *We didn't realize until we got up here that this would permit a parallel of the PRDC case.* As a result of the good counsel you gave us that rule has not been put into effect.

"*We are still operating under the original rule which requires that a finding be made that there is reasonable assurance, in effect, that this research program will be successful. We are pre-gauging the research program.*

"Senator Anderson. All I want to point out is not being a lawyer I can speak freely on any legal point. This struck me as a very interesting development. What I am trying to get to is that I think the Commission in this matter of the Peach Bottom case has proceeded the way it ought to proceed. *It ought to know the situation is completely safe. Until the Reactor Safeguards Committee comes in and says we think it is safe, I think the Commission has a perfect right and a great obligation to say, we agree we should take our time and be very sure of it.*" (Emphasis added) (Id. pp. 72-74)

There is nothing in the Act authorizing the issuance of construction permits with findings of safety limited to the construction period. To the extent that the Commission so interprets and applies its regulations, they are invalid.

Where the safety policy is so strongly stated by Congress as in this Act, and where the possibilities of harm are so enormous, any doubt as to what findings the Act requires should be resolved on the side of safety. A similar approach was demonstrated by this Court in *Shields* v. *Atlantic Coast Line Railroad* 350 U.S. 318, in construing the Safety Appliance Act of 1910. Section 2 of that Act provided that ". . . all cars requiring . . . secure running boards shall be equipped with such . . . running boards." Section 3 delegated authority to the Interstate Commerce Commission to designate "number, dimensions, locations and manner of application of the appliances provided by Sec. 2." The issue was whether running boards around the domes of tank cars were within Section 2, despite the fact that ICC regulations were silent about dome running boards. It was held that nevertheless the court could, and it did, determine that such running boards were within the sweep of Sec. 2, and that "considerations of administrative expertise relevant to Section 3 are not equally applicable to the effectuation of the purpose of Section 2," (p. 322), in view of the strong safety policy of that Act. See also *Baltimore and Ohio R.R. Co.* v. *Jackson* 353 U.S. 325.

There is probably no legislation in which the Congressional objective of protecting the health and safety of the public is so strongly evident as in the Atomic Energy Act of 1954, or one in which the administering agency is so frequently reminded of that objective. This may well have been necessary, among other reasons, because the *Commission promotes the industry it is charged with regulating* for security and safety purposes. In this potentially dan-

gerous conflict of interest, it is imperative that doubts as to interpretation, if any, be resolved in favor of safety.

Petitioners contend that the court should accept the statutory construction consistently made by the agency charged with administering the Act. As shown below (pp. 59-62; 78-80) the Commission has not been consistent in its interpretations or its actions, to say the least, but even if it had hitherto consistently taken the position it has taken in this case, that would not be persuasive or controlling, because "consistent error is still error." *Phillips Petroleum Co. v. Wisconsin* 347 U.S. 672, 678 n. It is still the obligation of the court to reconcile administrative interpretation with the broad policies laid down by Congress. *United States v. E. I. Dupont de Nemours & Co. et al.* 353 U.S. 586, 590; *Automatic Canteen Co. v. Federal Trade Commission* 346 U.S. 61, 74.

D. *Congress has not acquiesced in the Commission's interpretation and application of the Act and its Regulations in this case*

Petitioners contend that the history of the relationships between the Commission and the Joint Committee, with full explanation of the Commission's construction permit procedure, support the validity of the Commission's construction permit regulations.

The significant fact is that the Commission *never* discussed with the Joint Committee its present interpretation of these regulations, which appeared *for the first time* in its decision in this case. While on several occasions representatives of the Commission discussed the construction permit procedure in general terms with the Joint Committee, they did not present any interpretation of specific regulations. They did not assert that the Commission had no obligation to make an initial determination, at the time

of issuing a construction permit, that it believed the proposed reactor could be operated safely. Certainly they gave no intimation that the regulations on construction permits provide only, as the Commission declared in its Final Decision herein, that the *construction* of the reactor will not endanger the health and safety of the public (R. 643, 644).

The record is quite to the contrary. Petitioners rely heavily on the general statement made by Mr. H. L. Price, then Director of the Division of Civilian Application, to the Joint Committee on February 8, 1956, *before* the Commission's regulations were promulgated, and *before* any construction permit for power reactors had been issued. (Brief, No. 454, pp. 63, 64; Brief, No. 315, p. 50; R. 651-655). However, on June 13, 1956, *after* its regulations on the licensing of reactors was in effect, and *after* 3 construction permits for power reactors had in fact been granted (*infra*, p. 102), Mr. Price testified as follows, in response to a question as to what a private company must do to obtain a *license to build* an atomic power plant:"[39]

> "... If the project is entirely privately financed, the Company could file an application for a license. They have to make a showing of financial responsibility, technical competence of the people that are going to be in charge, and *they have to make a very detailed showing of the ways in which they will protect their employees and the public against the hazards of radiation* that have been talked about. *It is this evaluation from a hazard standpoint that is the most important and the detailed. That is the big part in licensing procedures.*" (Emphasis added)

[39] Hearings before Subcommittee of the House Committee on Appropriations on Second Supplemental Appropriation Bill, 1957, 84th Cong. 2nd Session, Part 2, p. 70.

As shown below (p. 78), that was in fact the procedure followed in the scores of construction permits issued for power, as well as research and development reactors, except that in the instant case.

Furthermore, the Commission did not keep the Joint Committee fully informed about its application of the construction-permit procedure. The first time the Commission gave the Joint Committee, on its request, a *detailed* statement of its application of that procedure was *after* the PRDC permit was issued, in a document dated October 9, 1956. *A Study of AEC Procedures*, etc. *supra*, pp. 100-108. The Commission then stated (id. p. 107) that, after various preliminary steps are taken,

> "The Commission staff reviews these reports as they are submitted, holds informal meetings with the applicant, discusses the safety aspects of the reactor with its advisers (ACRS), considers the progress of the developmental programs which are being carried out by the applicant, and finally arrives at a point when it believes that *there is reasonable assurance* that the unresolved safety problems can be resolved in a way that will make it possible for the applicant *to operate the proposed reactor at the proposed site without undue risk to the health, safety, and property of the public*. At this juncture, the Commission may issue a conditional construction permit." (Emphasis added)

That explanation is inconsistent with the position that the Petitioners now take on the point at issue. The statement makes it clear that the Commission interpreted its regulation to require a finding, at the time the construction permit is issued, that the proposed reactor, not merely the general type, could be operated at the proposed site without undue risk to the health and safety of the public.

Safety during the construction period, or for the purposes of a provisional construction permit, was not even mentioned.

This, then, was the understanding of the Joint Committee at the time as to the Commission's practice on this point. It is a far cry from the impression the Petitioners are trying to create. Subsequently, the Commission instituted measures to change the governing criteria in its regulations, but the effort was abandoned (*supra*, pp. 53-56).

Furthermore, as indicated above (p. 5 n.), Senator Anderson, Chairman of the Joint Committee at the time, and Representative Holifield, Chairman of the Committee now, were highly critical of the method followed in granting the permit. Congressional criticism of the failure of the Commission to keep the Joint Committee informed has been caustic and frequent.[31]

On one occasion there appeared to be a deliberate effort at concealment. The adverse report of the Advisory Committee on Reactor Safeguards on the PRDC application was sent to the General Manager of the Commission on June 6, 1956 (R. 587). On June 25, 1956, the Commission members appeared before a subcommittee of the House Committee on Appropriations,[32] and discussed, in response to questions from Representative Cannon, Chairman of that Committee, the problems delaying the PRDC project. No mention was made of the adverse safety report. On

[31] Section 202 of the A[illegible] requires the Commission to keep the Joint Committee "fully and currently informed with respect to all of the Commission's activities." However, the Commission has been repeatedly criticized for failing to comply with this statutory obligation. *Cf.* Hearings before Committee on Interstate and Foreign Commerce, 86th Cong., 1st Session, pp. 509-531, 606, 933-934.

[32] Hearings before Subcommittees of House Committee on Appropriations, 84th Cong., 2nd Session, Second Supplemental Appropriation Bill, 1957, Part 2, pp. 210-215; 238-240.

June 29, Commissioner Murray revealed to the Appropriations Committee that the report had been issued, and a heated colloquy ensued between Cannon and Lewis Strauss, Chairman of the Commission, concerning the failure to give the information earlier. During this exchange Commissioner Murray stated:

> "All of these designs are submitted, before approval, to our Reactor Safeguard Committee and a permit for construction and go ahead is not given until the committee approves."

Not until July 13, 1956, and only after insistent requests, did the Commission send a copy of the report to the Joint Committee, and then only with qualifications as to use.[33]

Congress disapproved of the only aspect of the PRDC proceeding that came before it for consideration. The Commission had agreed with PRDC to spend over $4 million on research work for the latter's reactor (*infra*, p. 17). When the Commission went to Congress for an appropriation to carry out this commitment, a substantial conflict developed, both in the Joint Committee and on the floor of Congress. The money requested for this purpose was denied, and specific reference was made to the objections which had been raised regarding the issuance of the permit in this litigation.[34]

Later, on July 14, 1958, Senator Anderson discussed the PRDC permit on the floor of the Senate, after a chemical experiment for the PRDC reactor injured several children. He stressed the fact that he had opposed issuance of the original PRDC permit against the advice of the Advisory

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[33] *A Study of AEC Procedures*, etc., *supra*, pp. 117-122.

[34] Hearings before the Senate Committee on Appropriations, Atomic Energy Appropriation Bill, H.R. 9379, 85th Cong., 1st Session, August 21, 1957, p. 10; Conference Report on H.R. 9379, August 23, 1957, p. 2.

Committee on Reactor Safeguards, and without the necessary testing beforehand. Part of Senator Anderson's comments are quoted in the margin.[35]

The foregoing record shows quite clearly that Congress did not acquiesce in the interpretation and application of the Commission's construction permit procedure as revealed in the present case.

Petitioners argue, finally, that the Joint Committee studied the permit procedure, but did not recommend any changes in the procedure regarding safety findings, in *A Study of AEC Procedures*, etc., *supra*. As already indicated, that study revealed that the Commission then expressed a different view of the matter than it expressed in the final PRDC decision, and that, in fact, members of the Joint Committee were highly critical of the Commission's procedure in the PRDC case. In any event, the study was a staff report. Representative Durham, Chairman of the Joint Committee at the time the study was published, stated in the foreword that it was not a committee report, contained no specific legislative recommendations, and the opinions expressed therein did not neces-

[35] "It was the position of those of us who opposed the issuance of that permit that an atomic reactor should not be built until a Reactor Safeguards Committee, consisting of able and conscientious men, should say it was safe; and that if additional experimentation were necessary before the permit was granted, such experimentation should be made. Such experimentation and emphasis on safety has been the practice in connection with the other atomic reactors. Only in connection with this private reactor were the operators given permission to go ahead against the advice of the Reactor Safeguards Committee, consisting of men of very fine character and high standing. . . .

"We know about pressurized water reactors. We know how to build certain types of them. When we enter a new field we should be sure that we have done all the necessary testing before construction begins. That was the ground upon which the Governor of Michigan intervened. I think wisely so. That was the point at which the labor unions entered the picture. They felt that before entering this field we should be sure that the process will work. I think they are on very sound ground." (104 Cong. Rec. 13593-13594, July 14, 1958)

sarily represent the views of the Committee or its individual members (id. p. IV).

In short, there has not been any Congressional acquiescence in the Commission's interpretation of its regulations, particularly Regulation 50.35, in the PRDC case. The foregoing history of the relations between the Commission and Congress shows (1) prior to the decision in this case, Congress was never informed of the Commission's interpretation of the regulations in issue; (2) both before and after the issuance of the original permit, the Commission informed Congress that its practice was to make a careful evaluation of, and an affirmative finding on, safety of operation of a proposed reactor before issuing a construction permit (*supra*, pp. 59-60). (3) members of the Joint Committee were highly critical of the issuance of the PRDC permit without adequate safety findings (*supra*, p. 5); (4) because the Commission issued the original PRDC permit without a hearing, and despite an adverse safety report from its Advisory Committee on Reactor Safeguards, and in view of the Commission's execution of a contract to give PRDC research and development assistance while the legality of its permit was being litigated, Congress adopted what it deemed appropriate amendments to the Act to regulate those aspects of Commission activity; (*supra*, pp. 15-17); (6) the Joint Committee expressed disapproval of an amendment to Regulation 50.35 which would have incorporated the rationale of the PRDC decision, and that amendment has not been promulgated (*supra*, pp. 53-56); and (7) Congress was highly critical of the failure of the Commission to keep the Joint Committee and other Congressional committees fully informed (*supra*, p. 61). In the light of that history, any contention that Congress acquiesced in the Commission's interpretations of its powers under the Act is utterly groundless.

E. The Commission failed to make the necessary findings on safety of operation of the PRDC reactor

1. The Commission's findings on safety do not conform to the requirements of the Act.

Petitioners do not contend that the Commission found that the PRDC reactor will operate with adequate protection for the health and safety of the public.

The Petitioners contend, however, that the Commission's action does conform to the 2-step licensing procedure provided by the Act, and that the Commission's finding does comply with the statutory requirements for the first step. Their contention is that the Act does not, in fact, impose any safety requirement for the first step, namely the issuance of the construction permit, but does do so only for the second step, when permission to operate is granted. As already shown above, this contention misconstrues the nature of the statutory 2-step procedure.

The basic safety finding must be made at the first step, and the second step consists, in substance, of determining whether the conditions of the construction permit have been complied with.

As the legislative history reveals, the two-step licensing procedure established by the Act is a method designed to effectuate the overriding interest of Congress in protecting public health and safety, while at the same time enabling investors to undertake to build these very costly facilities with assurance of a license to operate them if they construct the facilities in accordance with the conditions of the construction permit. Without such assurance, it would be utterly irrational to expect such substantial investments to be made. This objective was most clearly expressed in the report by the Joint Committee on the bill that became the Act when it stated that "Section 185 . . . requires the issuance of a license if the construction is carried out in

accordance with the terms of the construction permit." (*supra*, p. 40)

There is nothing in the court's decision which would interfere with that 2-step procedure. The fact that the Commission must make a finding of safety of operations, at the time the construction permit is issued, does not mean that this is the "definitive and final" determination of safety. The Commission must still determine, after completion of construction, whether or not the conditions of the construction permit have been carried out. A determination that adequate protection has been provided for health and safety of the public cannot be definitive and final until construction has been completed in accordance with the terms of the construction permit, and the Commission has so found. The court below said nothing to the contrary.

As shown by the statements made by Senators Humphrey and Jackson, (*supra*, pp. 41-42) without dissent from any Senator, Congress was concerned lest there be tremendous pressure to obtain licenses generated by those who had spent many millions of dollars on construction, were there not previous assurance that licenses would be granted if the condition of the construction permit were met. In this case, for example, reasonable men cannot blind themselves to the fact that once PRDC had spent the $80 million or more that will be required to complete construction of this project, the pressure on the Commission to resolve all doubts on safety in favor of PRDC may well be irresistible. The statement of the Government that "the Commission is not concerned with the financial investment made by the applicant" (Brief, No. 454, p. 53), when that investment is $80 million, is naive, to put it mildly. It was to avoid such a situation and to make certain that the safety

question was searchingly examined by the Commission at the outset that the 2-step procedure as set forth in Section 185 was devised. The Federal Communications Commission has recognized the danger that Congress sought to avoid in matters of this kind, *WSAU, Inc. and WJIV-TV*, 10 R.R. 402.

The Commission has already demonstrated the validity of this Congressional concern. On August 3, 1957 (before the taking of testimony in this case had been completed), the chairman of the Commission sent a letter to Representative Sterling A. Cole, former chairman of the Joint Committee, expressing irritation over the Congressional attitude toward the contract between the Commission and PRDC for governmental assistance on the PRDC reactor, (*supra*, p. 62). The letter states, in part:

> "In the PRDC contract, the Commission, in consideration of expenditures by PRDC and its affiliates, estimated at about $58 million, undertook to contribute up to 4.2 million dollars to the cost of certain specific research and development needed for the reactor project. *PRDC and its affiliates had already spent very substantial sums in reliance on the Commission's undertaking to provide this assistance* . . . We believe that under the circumstances PRDC in justice is entitled to assurance that the appropriations necessary for the Commission's undertakings are authorized." (Daily Congressional Record, A6319-5320, August 5, 1957; Tr. 3906, 3907.) (Emphasis added)

2. The Commission's findings on safety do not conform to the requirements of its regulations.

The original permit to PRDC did not contain any finding that the proposed reactor could operate safely. The Com-

mission did consider the problems relating to the safety of operation, but made only the following statement in the permit:

> "(2) On the basis of information presently available, the Commission believes that the problems relating to the safety of operation of the PRDC reactor will prove to be of a kind that can be satisfactorily resolved within a reasonable time. There is some doubt whether they can be resolved in time to meet the schedule proposed by PRDC in its application and it may turn out that further investigations beyond the program of investigation outlined by PRDC in its application will be needed." (R. 518).

The Commission does not contend that it did make the requisite finding on safety at that time. Its answer to the Respondent's objection on this score, given in the Final Decision was, "Even if the Commission had erred in issuing the original construction permit, such error would not be prejudicial to the Intervenors, because they were afforded every opportunity on the record to develop the safety and financial issues" (R. 663).

Apparently it is not a matter of importance in the administration of the Act that a construction permit be illegally issued, and the applicant be authorized to spend many millions of dollars over a period of almost 3 years before an attempt at correction is made, because, after all, the objectors were given a hearing after the permit was issued!

Petitioners have made no attempt to argue that the original construction permit was properly issued. Indeed, almost at the very outset of these proceedings, but after it had been granted the construction permit, PRDC inferred its belief (1) that a finding of safety of operation

was required to support the construction permit, and (2) it could not sustain the burden of establishing such safety. Those inferences can fairly be drawn from the request for an exemption from Regulation 50.35 which PRDC filed on December 10, 1956, (R. 396-397). It sought exemption from the requirement of that Regulation that the Commission "be satisfied . . . it has information sufficient to provide reasonable assurance that a facility of the general type proposed can be *operated* at the proposed location without undue risk to the health and safety of the public."

In its Order permitting Respondents here to intervene to challenge the validity of the permit, the Commission refused to include the issues as stated by Respondents, but limited and specified the issues to be heard. The basic specifications were as follows (R. 578):

> "A. 1. Whether there is information sufficient to provide reasonable assurance that a utilization facility of the general type proposed in the application can be constructed and operated at the location proposed therein without undue risk to the health and safety of the public.
>
> "2. Whether there is reasonable assurance that technical information omitted from and required to complete the application will be supplied."

Both Respondents and PRDC requested that these issues be modified, but the Commission refused to allow any changes (Tr. 6399, 6407, 6416, 6426, 6440).

Issue A, as specified, uses verbatim the words of Regulation 50.35 on the safety finding required, including safety of operation at the proposed site. Furthermore, the manner in which the issues are stated shows the Commission's view of the order of priority. The *first* issue to be determined, set forth in A.1, is whether there *is* information

sufficient to provide reasonable assurance of safety. The *second* issue is whether necessary technical information omitted from the application will be supplied. This is the order of priority stated in the regulation, namely, if there is the necessary assurance of safety of operation at the time action is to be taken on the construction permit, the Commission may issue the permit if it believes the omitted information will be supplied.

The statement of the issues specified by the Commission established the framework of this proceeding. They also determined the nature of the findings that the Commission would have to make. The Commission declared in its order that "the applicant for the permit must demonstrate at the hearing that it is able to satisfy those requirements of law and the Commission's regulations which are in controversy" (R. 582). What those requirements were was stated in the specified issues.

During the hearing a substantial part of the technical evidence offered by PRDC related to safety of operation of its proposed reactor (*supra*). Neither PRDC nor the AEC staff raised any question as to the necessity for offering such evidence.

In its Initial Decision, the Commission made the following basic finding on safety:

> "22. The Commission finds reasonable assurance in the record that a utilization facility of the general type proposed in the PRDC application and amendments thereto can be constructed and will be able to be operated at the location proposed without undue risk to the health and safety of the public." (R. 615)

This finding is substantially in accord with the language of Regulation 50.35. However, in its Final Decision the Commission deliberately modified this finding:

"22. The Commission finds reasonable assurance in the record, *for the purposes of this provisional construction permit*, that a utilization facility of the general type proposed in the PRDC application and amendments thereto can be constructed and operated at the location without undue risk to the health and safety of the public." (R. 708) (Emphasis added).

The new words "for the purposes of this construction permit" are not mere surplusage, as Petitioners strive hard to establish. They are highly significant. They were used after the Commission had an opportunity to re-examine its Initial Decision, and are used only in this and 2 other numbered findings (R. 710, 711; Findings Nos. 30 and 34). If these words were intended merely to describe the fact that the findings are made in a provisional construction permit, there was no reason to limit their use so narrowly, since *all* the findings were made in a provisional construction permit. The use of this qualification makes it clear that the Commission was not making a present finding with respect to safety of operation.

But Regulation 50.35 permits no qualification of a finding of safety limited to the purposes of a provisional construction permit. The Act contains no such qualification.

The conclusion that the Commission was seeking, in its Final Decision, to throw off restrictions on its freedom of action, which it recognized in its Initial Decision, is shown in its discussion of Regulation 50.40, relating to common standards. (*supra*, pp. 11-12; 46-47). In its Initial Decision, the Commission stated that Regulation 50.40 is its basic statement of the standards under which the Commission will issue licenses, but does not otherwise comment on or interpret it (R. 928). In its Final Decision, the Commission concedes that in this regulation "license" covers "construction permit" (R. 643). However, although the in-

formation required by that Regulation specifically relates to operation of the proposed reactor, the Commission asserts the regulation relates only to construction when the matter involved is a construction permit for a developmental reactor (R. 644). Not only is there absolutely no language in that regulation to support such an interpretation, but this is the first time the Commission made it.[36]

Yet despite this insistence that its findings need relate only to construction safety, the Commission seems to recognize that some finding of operating safety is required. It declares in its Final Decision that "The degree of reasonable assurance with respect to safety that satisfies us in this case for purposes of the *provisional* construction permit would not be the same as we would require in considering the issuance of the operating license." (Emphasis in original) (R. 679). This statement, which refers to Regulation 50.35, makes it clear, first, that the Commission does place critical significance on the phrase "for the purposes of the *provisional* construction permit." Secondly, it indicates there must be reasonable assurance as to safety of operation at the time the construction permit is issued, otherwise the asserted difference in the "degree" of reasonable assurance would be meaningless. Thus the Commission has nullified so much of its argument as seeks to establish that a finding of safety of operation is not required when the construction permit is issued. The fatal difficulty with its rationalization, however, is that it so dilutes the standard and renders the finding so vague and uncertain, particularly when compared to the earlier find-

[36] The Commission also asserts that a construction permit is not equivalent to a license (R. 644). This is in flat contradiction to the statement of Senator Hickenlooper, manager of the bill in the Senate, declaring that "A license and a construction permit are equivalent. They are the same thing, and one cannot operate until the other is granted." (*supra*, p. 42).

ing in the Initial Decision, that it cannot be deemed to be a finding of safety of operation.

Examples of the Commission's lack of conviction can be multiplied. In its Initial Decision, the Commission made the following finding:

> "30. *Data presently available* indicate that a reactor of the general type described in the application can be so designed that no credible accident in the course of its operation is likely to result in the release of *significant quantities of fission products* into the atmosphere; this conclusion *has not been demonstrated sufficiently at this time to justify issuance of an operating license.*" (R. 617) (Emphasis added).

This is certainly not a finding which leads to reasonable assurance of operating safety. Yet the Commission retreated even from this position in its Final Decision. The foregoing finding was then modified as follows:

> "30. *For the purposes of a provisional construction permit*, there is reasonable assurance that a reactor of the general type described in the Application can be so designed that no credible accident in the course of its operation is likely to result in the release of significant quantities of fission products into the atmosphere." (R. 710) (Emphasis added).

The Commission was apparently unwilling to derive any conclusions on credible accidents from the "data presently available." And the statement that "this conclusion has not been demonstrated," etc., becomes "for the purposes of a provisional construction permit."

Repeatedly the Commission failed to find reasonable assurance on the basis of data available to it at the time

of issuing the permit. For example, its 18th finding states (R. 706):

> "a. It has not been positively established that a fast breeder reactor of the general type and power level proposed by Applicant can be operated without a credible possibility of releasing significant quantities of fission products to the environment;
>
> "b. There is reasonable assurance that theoretical and experimental investigations which have been undertaken, together with operating experience on one or more of the EBR-I, EBR-II and Dounreay [37] reactors, will establish definitively, prior to the scheduled completion date of the PRDC reactor, whether or not the reactor proposed by Applicant can be so operated; [38]
>
> "c. There is reasonable assurance that evidence will establish that the reactor proposed by Applicant can be so operated."

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[37] The construction of EBR-II has not yet been completed, let alone operated. On March 1, 1961, the Commission issued an official report stating that, as of the end of February 1961, installation of equipment in this project was approximately 65% completed. *(Summary Status of the ANL Fast Breeder Reactor Program Pertinent to the PRDC Case.)* John A. McCone, when Chairman of the Commission, recently expressed the opinion that it was "bad timing" to be building the PRDC reactor at the same time as the EBR-II, because the former "cannot benefit by the improvements that we are going to prove out in the EBR-II." (Hearings on Development, Growth and State of Atomic Energy Industry, Joint Committee on Atomic Energy, 86th Congress, 1st Session, February 18, 1959, p. 98.) Dounreay is operating at a low power level and a number of unique fast reactor problems have not yet been solved. *Symposium on the Dounreay Fast Reactor,* British Nuclear Energy Conference, London, December 7, 1960, p. 85.

[38] At the time of that finding the scheduled completion date of the PRDC reactor was December 15, 1960, (*supra*, p. 5). On November 18, 1960, the Commission extended the completion date (*supra*, p. 9) without determining that operating experience on EBR-I, EBR-II, or Dounreay reactors had established that the PRDC reactor could be operated without a credible possibility of releasing significant quantities of fission products to the environment.

Assurance that investigations under way "will establish definitively . . . *whether or not* the reactor proposed by Applicant" . . . "can be operated without a credible possibility of releasing significant quantities of fission products to the environment" obviously implies that the evidence does not now establish, or give reasonable assurance, that the reactor can be so operated.

The Commission's findings on the safety of the site reveal similar attenuation. Regulation 50.35 requires a finding of safety with respect to operation of the reactor *at the proposed site*. In its Initial Decision, the Commission found, (R. 617, 618):

> "32. The proposed site is generally suitable for *a reactor of the type and size described in the Application, if the reactor is otherwise shown to be capable of operation without undue hazard*, including demonstrations of stability and adequate containment. Adequate investigations are under way to establish the characteristics of the chosen site, including all relevant aspects, *and the record shows that to this point the site is satisfactory from the standpoint of protection of the public from undue hazard.*" (Emphasis added)

Although this is not an adequate finding, it constitutes a recognition that a determination of suitability of site must be made in relation to safety of operation of the reactor.

In its Final Decision, however, the Commission omits the portion of this finding to the effect that the site is satisfactory "to this point" (R. 710, 711):

> "32. There is reasonable assurance that the *proposed site is generally suitable* for a reactor of the type and size described in the Application, *if the reactor is otherwise shown to be capable of operation without*

> *undue risk to the public health and safety*, including demonstrations of stability and adequate containment. Adequate investigations are under way to establish the characteristics of the proposed site, including all relevant aspects with respect thereto." (Emphasis added)

The Commission would get no nearer to a finding on safety of operation at the proposed site than to say that "*safe operation* of *the reactor* will be as likely in that location *as in any other*." (R. 678). These are not findings that the reactor can operate safely at the proposed site.

There is another equally serious defect in this site finding. So far as the conditions of the site itself are concerned, the Commission says only that "Adequate investigations are under way to establish the characteristics of the proposed site, including all relevant aspects with respect thereto." The investigations "under way" must determine (1) what the characteristics are, and (2), how these characteristics affect the suitability of the site. For example, in case of a nuclear accident, "the consequences would depend on the meteorological conditions at the moment as well as upon the nature of the fission products released." (R. 678). The Commission's Final Decision states no reason for lack of the necessary information at the time the PRDC application was considered and acted upon.

Petitioners rationalize their interpretations of the Act and the Commission's regulations on the ground that "there are often uncertainties and technological problems that can be resolved only during the course of construction." (Brief, No. 454, pp. 45-48; No. 315, pp. 30-34). Petitioners do not, however, state any reason to justify the lack of necessary information on site characteristics, such at its meteorology, geology, hydrology, etc. Assuming,

arguendo, that the rationale of Petitioners regarding demonstration of *reactor* characteristics is valid, that rationale has no application to *environmental* information. Applicants do not have, and of course do not claim, the power to affect or change the meteorological characteristics of the site, and no improvements in technology can alter that fact. There is even less excuse, accordingly, for speculation as to site characteristics, and for lack of a present finding of site suitability, than in the case of reactor characteristics.

Once a reactor is built, the site selection is irrevocable. The only aspect of the project that would be subject to change is the reactor itself. In effect, therefore, Commission approval of a site for a construction permit is final. The Commission candidly recognized this in its proposed amendment to Regulation 50.35 (*infra*, pp. 100-101), when it proposed to provide, in substance, that the finding of site safety at the time of issuance of the construction permit would be final, inasmuch as its proposed subsequent proceedings do not include reference to site considerations.

The issuance of a construction permit by the Commission in violation of its own regulations, adopted pursuant to statutory authority, is a violation of the Act. Regulations validly prescribed by a government agency are binding upon the agency as well as the citizen, *Accardi* v. *Shaughnessy* 347 U.S. 260, and this principle holds even when the administrative action under review is discretionary in nature, *Vitarelli* v. *Seaton* 359 U.S. 535; *Service* v. *Dulles* 354 U.S. 363. Cf. *Bridges* v. *Wixon* 326 U.S. 135; *Chapman* v. *Sheridan Wyoming Co.* 338 U.S. 621, 629.

Consequently, an additional reason for upholding the decision of the court below is that the Commission has failed to make the safety findings required by its Regulations.

3. The Commission failed to answer its own specifications of the safety issue in this case.

As shown above, the Commission framed the issues in this case itself, and rejected efforts of the Petitioners to modify them. The safety issue as drawn by the Commission was not limited to the purpose of a provisional construction permit. The main thrust of the protest related to what might happen during operation. (R. 524; Brief, No. 315, p. 11). The stated issues gave no indication that the Commission was trying to avoid, or would not deal with, what the parties considered the paramount questions.

The Commission did not answer the safety question which it had formulated, namely was there reasonable assurance of safety of operation at the proposed location, but limited its answer to the construction period. Since the Commission initially considered the questions it framed as being basic to a determination of the validity of the permit, its decision is fatally defective because it failed to answer those questions. *Boudin* v. *Dulles* 235 F. 2d 532; *Burrell* v. *Martin* 232 F. 2d 33.

4. The Commission's action in this case is inconsistent with its practice in all other similar cases.

Petitioners make *undocumented* assertions that the Commission's action in this case is the same as in all other cases involving construction permits for developmental power reactors. These assertions are simply contrary to fact.

The Commission issued three construction permits for developmental power reactors prior to issuing the original PRDC construction permit,[39] and five thereafter.[40]

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[39] *Consolidated Edison Co.* (CPPR-1; 21 F.R. 3084); *Commonwealth Edison Co.* (CPPR-2; 21 F.R. 3085); *General Electric Co.* (CPPR-3; 21 F.R. 3395.)

[40] *Yankee Atomic Electric Co.* (CPPR-5; 22 F.R. 7188, 9237); *Saxton*

In *all* of them, the Commission made safety findings in the words of Regulation 50.35, stating that the applicants had submitted information sufficient to provide reasonable assurance that a utilization facility of the general type proposed could be constructed and operated at the proposed location without undue risk to the health and safety of the public. *None* of them contained any qualification that the finding was made "for the purposes of a provisional construction permit." In all of them, the Commission had, in fact, initially found that the specific reactor applied for could operate safely.

In addition, up to the time of the dismissal of the petitions for rehearing by the court below, the Commission had issued 58 construction permits for research and development reactors. In those, the Commission either made the same safety finding as in the 8 power reactor permits mentioned above, or explicitly found that the reactor proposed could operate safely. Likewise, none of them contained any qualification "for the purposes of a provisional construction permit".

These permits show that the Commission has generally "pursued a course impossible to reconcile with present contentions of the Government" (*U.S.* v. *Gerlach Live Stock Co.* 339 U.S. 725, 739).

In the light of that record of performance, there is no basis whatever for the contention of the Petitioners that the interpretation for which Respondents contend would drastically alter the Commission's actual procedures, or would interfere with development of the atomic energy industry contrary to contemplation of the Act.

Nuclear Experimental Corp. (CPPR-6; 24 F.R. 9244; 25 F.R. 1471); *Carolinas, Virginia Nuclear Power Associates, Inc.* (CPPR-7; 25 F.R. 522, 4206); *Northern States Power Co.* (CPPR-8; 25 F.R. 254, 4484); *Consumers Power Co.* (CPPR-9; 25 F.R. 1699, 5002.)

F. *The Commission's findings are, at best, ambiguous*

As shown above, Respondents believe it is clear that the Commission has failed to make the safety findings required by the Act and the Commission's regulations.

The court below, after carefully examining the findings, pointed out a number which fall short of indicating assurance with regard to safety of operation (R. 960-962). The court concluded that a finding of safety "for purposes of a provisional permit," and the predictions regarding the future course of scientific development, do not satisfy the requirements of the Act. (R. 961, 962). Other defective findings are cited *supra*, pp. 67-77.

On the other hand, the court pointed out a few "expressions which might seem to indicate a positive opinion regarding safety of operation." (R. 963).

One of the outstanding contradictions in the Final Decision, and one of its basic defects, is its treatment of the question of whether the finding of safety must relate to the specific reactor for which the permit is sought. On the one hand, the Commission asserts that, for the purposes of a provisional construction permit, it is enough "for the satisfaction of the requirements of the statute and the regulations that there be reasonable assurance that *the reactor* can be constructed and *operated* without undue risk to the health and safety of the public" (R. 676, 677) (Emphasis added). On the other hand, its principal finding on safety applies only to the general type of reactor proposed (R. 708), and the Commission insists that its finding on safety need relate only to the construction period (R. 643, 644).

The result, in the opinion of the court, is that the Commission's findings regarding safety of operation are ambiguous. In its view, the nature, size, and location of the project require that the findings be free from ambiguity, and that the Commission failed to make the basis of its

action reasonably clear; until that is done, the court is not obliged to determine the validity of the Commission's decision. *Secretary of Agriculture* v. *United States*, 347 U.S. 645, 654; *Radio Station KFH Co.* v. *Federal Communications Commission*, 247 F. 2d 570, 572; *Pacific Far East Line, Inc.* v. *Federal Maritime Board*, 275 F. 2d 184, 187. See also *Eastern Central Motor Carriers Association* v. *United States*, 321 U.S. 194, 211; *United States* v. *Chicago, Milwaukee, St. Paul Railroad Co.*, 294 U.S. 499, 510.

The Government seeks to explain away what the court charitably called ambiguities by saying they involve "no more than the distinction, clearly drawn in the regulations" between the two types of findings for a construction permit for a *developmental reactor*, namely, (1) a *present* conclusion as to safety of the general type of reactor proposed, and (2) a *tentative* conclusion as to eventual demonstration of the safety of the final design, citing Regulations 50.35 and 50.40. (Brief, No. 454, pp. 69-70).

The obvious weaknesses of this explanation are (a) these regulations, as shown above, make no express or implied provision for developmental reactors as distinguished from other types; (b) the Commission failed to make a *present affirmative* finding of safety of *operation* as these Regulations require; (c) the regulations do not provide for issuance of a construction permit, without a finding of safety of operation, conditioned upon the outcome of the applicant's research and development program. Significantly, the Government does not refer to any provision of the Act or the regulations to support this dichotomy between present and tentative conclusions.

The answer of PRDC on this point simply misconstrues the opinion of the court below. It asserts that the court's determination of ambiguity stems from "the mistaken premise that a definitive finding of safety of the reactor as

initially designed is required for issuance of a provisional construction permit" (Brief, No. 315, p. 37). There is no language in the court's opinion which can reasonably be construed to mean what PRDC says it means. There is nothing in the court's opinion requiring a definitive determination with respect to a precise reactor design.

In sum, neither the Government nor PRDC adequately meet and counter the court's conclusion as to ambiguity of the Commission's findings. They make no attempt to rebut the principle enunciated by the court that ambiguity of the findings would require reversal of the Commission's decision.

II

THE HOLDING OF THE COURT BELOW THAT THE COMMISSION'S SAFETY FINDINGS ARE INSUFFICIENT IS NOT BASED ON THE FAILURE OF THE COMMISSION TO FIND "COMPELLING REASONS" FOR APPROVING LOCATION OF THE PRDC REACTOR NEAR A DENSELY POPULATED AREA.

The Petitioners misconstrue the opinion of the court below with regard to its holding regarding safety of the site of the reactor.

The Government argues that the statement of the court of appeals that the "Commission's safety findings are deficient in an additional respect" refers to the failure of the Commission to find that there were "compelling reasons" for locating the PRDC reactor near a densely populated area (Brief, No. 454, p. 75). The Government asserts that the error of the majority of that court lay in "requiring a special subordinate finding" of such reasons (ibid. p. 78).

PRDC, however, does not discover such a requirement. Its position is that this aspect of the opinion of the court below constitutes "an alternative ground of decision" (Brief, No. 315, pp. 23, 55, 56).

After stating that the Commission's safety findings are

deficient in an *additional* respect, having previously discussed the findings concerning the reactor itself, the court points out (R. 964) that the record shows (1) a report by the Commission to the Joint Committee on the possible injuries to persons and property if certain hypothetical major accidents occurred (R. 349-363); (2) undisputed testimony before the Commission that there is a possibility of a major disaster even though it has a low probability; (3) the Commission statement that "the question of safety obviously cannot be considered without regard to proposed location" (R. 677); and (4) the Commission finding that more than 2 million people live within a radius of 30 miles from the site (R. 707).[41]

Nevertheless, as the court pointed out (R. 964, 965), the Commission discussed physical characteristics of the site, including weather, hydrology and geology, and concluded:

> "Although the data of these types are not yet complete or conclusive, the record gives reasonable assurance that the *safe operation* of *the reactor* will be *as likely in that location as in any other location.*" (R. 678) (Emphasis added).

Neither this finding, nor any other finding or discussion by the Commission (R. 677-678, 706-708), relates the site problem to population density. Incidentally, the quoted finding definitely relates to the safety of *operation*, of the PRDC reactor, and is not limited to the "purposes of a provisional construction permit" for a general type of reactor.

[41] Assertions by Petitioners that the Commission's site findings are uncontested is completely unwarranted. Respondents not only took exception to site findings in the Initial Decision (*supra*, p. 10) to which the Commission sought to reply in its Final Decision (R. 677-679; 706-708), but one of the basic issues presented to the court below was that the Commission failed to make proper findings with respect to safety of the reactor *at the proposed site* (R. 951-952).

The crucial significance of this finding is that it treats the site problem at this location no differently than it would if the reactor were to be operated at some remote location. But, as the court points out, the Commission simultaneously takes the position, quite inconsistently, that if the meltdown investigation, which goes to the heart of the safety question, proves inconclusive, it will be necessary to consider the question of need for a prototype at a remote location (R. 965, footnote; 705-706).

It was in the light of the foregoing considerations, in addition to the deficiency of the safety findings which the court discussed in the earlier part of its opinion, that the court held the findings as to site safety "clearly insufficient." This is the only fair reading of the court's opinion on this point. The court did not say the finding was insufficient because it lacked a statement of "compelling reasons" for locating the reactor at the site involved.

The Government concedes the crucial importance of the population question. Its brief states:

> "It is obvious, of course, that when all other conditions are the same, a power reactor located near a city creates a greater risk of harm than the identical plant located in the wilderness." (Brief, No. 454, p. 81).[42]

This is flatly inconsistent with the finding of the Commission quoted above (*supra*, p. 83). The Commission's opinion makes no such admission. The Government argues, however, that there are "offsetting advantages" which justify the Commission's approval of the reactor at the location selected. It admits that the Commission "did not specifically discuss these offsetting advantages." It asserts, however, "they were the implicit framework within

[42] The reference to "wilderness" is completely factitious. The Respondents did not propose placing the reactor in a wilderness.

which its decision was made," and then proceeds to enumerate a list of such advantages (Brief, No. 454, pp. 81-83).

It is apparent that these "offsetting advantages" are tantamount to the "compelling reasons" which the Government claims the court below required. In short, the Government in fact concedes the principle which it is ostensibly attacking. If such a requirement indeed obtains, the fatal flaw in the argument is that the Commission's Final Decision does not support this list, or any other list, of "offsetting advantages" in placing this reactor near a densely populated area.

The Government concludes this part of its argument with the statement that "We do not overlook the fact that although these considerations may be reasons for licensing a reactor in a populated area, *the proximity of the population demands a higher degree of safety.* The Commission acknowledges this and took it into account in the findings" (Brief, No. 454, p. 83) (Emphasis added).

The Commission not only did not take population density into account, but actually rejected this concept.[43] In its Initial Decision, the Commission found (R. 614, No. 21):

> "A definitive evaluation of the suitability of the *proposed site* cannot be made at the present time. *In view of the population density around the site its suit-*

[43] PRDC, however, sought protection against this contingency of catastrophe. One of the conditions stated in its Application was that it be assured of its ability to obtain adequate liability insurance to cover *operation* of the reactor (R. 386). Walker Cisler, president of PRDC, testified, prior to the issuance of the construction permit, that the private insurance industry could not, and would not, assume the risk, because despite all their care "The danger of catastrophe still exists." He proposed that the Federal Government provide catastrophe liability protection *without an upper limit.* (Hearings before Joint Committee on Atomic Energy on Governmental Indemnity for Private Licenses, etc., 84th Cong., 2nd Session, May 16, 1956), pp. 126-127.

> *ability for the proposed reactor* depends upon the inherent safety of the reactor and a demonstration that no credible accident can release significant quantities of fission products into the atmosphere. If the foregoing are established, and there is reasonable assurance they can be, it is probable that the site will prove suitable for the proposed reactor." (Emphasis added).

This is a very guarded statement which makes population density the prime environmental consideration, and relates suitability of the site to the inherent safety of the proposed reactor.

In its Final Decision, however, the Commission changed that finding as follows (R. 707, No. 21):

> "A definitive evaluation of the suitability of the *proposed reactor* depends upon the inherent safety of the reactor and a demonstration that no credible accident can release significant quantities of fission products into the atmosphere. If the foregoing are established, and there is reasonable assurance they can be, the site will prove suitable for the proposed reactor." (Emphasis added).

The changes were drastic. The population density criterion was dropped. Dependency of the suitability of the proposed site on the inherent safety of the reactor was dropped. Complete silence enveloped the question of a present evaluation of the suitability of the "proposed" site, on which construction of the reactor had been proceeding for almost 3 years at the time of the Final Decision.

The court did not, however, directly or by inference, hold the findings on safety insufficient because of the lack

of a statement of "compelling reasons." This was made clear beyond any doubt by the court's statement that:

> "We *need not consider* whether even the most compelling reasons for preferring this location could support a finding that the reactor could be operated at that location without 'undue' risk or with 'adequate' protection, to the health and safety of the public." (R. 965) (Emphasis added).

In other words, the absence of a statement of "compelling reasons" (or "offsetting advantages") was not considered by the court, because the most compelling reasons are not a substitute for sufficient safety findings concerning the reactor itself. In short, the general remarks of the court concerning Congressional intent on the matter of compelling reasons are dicta.[44]

PRDC recognized the difficulty of asserting that the absence of a statement of "compelling reasons" was an alternative basis of the court's decision, in view of the fact that the court also stated that, in the light of the record, "We need not consider" that matter. The PRDC solution is to declare that the *latter* statement of the court is "dictum"! (Brief, No. 315, p. 18). By a piece of verbal legerdemain PRDC concludes that the effect of the "dictum" is to place a limitation on the power of the Commission to approve any large power reactor near a densely populated area. This is a fantastic distortion. The plain meaning of the court's statement is that it was not considering the matter of compelling reasons for locating a reactor at this site, because no such reasons, no matter

[44] It should be noted, nevertheless, that there was considerable Congressional concern over the location of reactors, as expressed, for example, by Representative Hinshaw, a member of the Joint Committee (*supra*, note p. 39).

how strong, could justify placing a reactor at this site if the reactor were not safe.

The Government, on the other hand, apparently concluded it could not satisfactorily explain away the court's statement that it was not considering the absence of compelling reasons, and therefore elected to ignore it.

If we assume, *arguendo*, that the lack of finding of "compelling reasons" is an alternative basis of decision of the court below, and the court was wrong, there would be no ground for reversing the decision since, as shown above, the court's primary basis of decision was proper. This is sufficient to uphold the decision. *Helvering* v. *Gowran*, 302 U.S. 238, 245; *Riley Investment Co.* v. *Commissioner of Internal Revenue*, 311 U.S. 55; *Brown* v. *Allen*, 344 U.S. 443, 459; *Freg & Son* v. *Cudahy Packing Co.*, 256 U.S. 208, 210.

A. *Proposed regulation on site selection.* At the time the construction permit for the PRDC reactor was issued, the Commission had no regulation establishing criteria for site selection, and has none in effect today. However, perhaps prodded by the decision of the court below, it has prepared and published a proposed regulation on Reactor Site Criteria, 10 CFR 100, 26 F.R. 1224, February 11, 1961. In its statement of considerations, the Commission declares:

> "The basic objectives which it is believed can be achieved under the criteria set forth in the proposed guides, are:
>
> "(a) Serious injury to individuals off-site should be avoided if an unlikely, but still credible, accident should occur. (b) Even if a more serious accident (not normally considered credible) should occur, the number of people killed should not be catastrophic. (c) The exposure of large numbers of people in terms of total

population dose should be low. The Commission intends to give further study to this problem in an effort to develop more specific guides on this subject. Meanwhile, *in order to give recognition to this concept, the population center distances to very large cities may have to be greater than those suggested by these guides.*" (Emphasis added).

It is apparent from this statement that population density is proposed as a major consideration. The criteria are grouped in 3 classes (Section 100.10) namely, (a) population density, (b) physical characteristics of the site, and (c) characteristics of *the proposed reactor* (not general type). If the PRDC reactor had been proved out, its proximity to a big city would be acceptable under the proposed criteria. However, the proposed regulation states [Section 100.2 (b)]:

> "For reactors which are novel in design, unproven as prototypes,[45] and do not have adequate theoretical and experimental or pilot plant experience, these criteria will need to be applied more conservatively. This conservatism will result in more isolated sites—*the degree of isolation required depending upon the lack of certainty as to the safe behavior of the reactor.*" (Emphasis added).

[45] The PRDC reactor clearly falls within the category of reactors described. The record in this case shows that EBR-I, the only fast breeder reactor that preceded the PRDC permit, built and operated at the remote testing grounds at Arco, Idaho, suffered an "excursion" and emitted radioactive fission products into the atmosphere. Mr. Cisler, president of PRDC emphasized, shortly before the issuance of the original construction permit, the experimental nature of his project. "The construction of the (PRDC) reactor may be quite properly viewed as the construction of a laboratory." Hearing before Subcommittee of Senate Interstate and Foreign Commerce Committee, 84th Cong., 2d Session, p. 144, April 18, 1956.

It thus appears that the Commission has belatedly recognized the importance of considering population density in selection of sites for power reactors.

Conclusion

The judgment of the Court of Appeals should be affirmed.

Respectfully submitted,

BENJAMIN C. SIGAL,
1126 Sixteenth Street, N. W.,
Washington, D. C.
Attorney for Respondents

HAROLD CRANEFIELD,
LOWELL GOERLICH,
Of Counsel.

MARCH 1961

APPENDIX A

STATUTES AND REGULATIONS INVOLVED

1. The Atomic Energy Act of 1954, 68 Stat. 919, as amended, 42 U.S.C. 2011, *et seq.*, provides, in part:

> Sec. 2. Findings.—The Congress of the United States hereby makes the following findings concerning the development, use, and control of atomic energy: . . .
>
> b. In permitting the property of the United States to be used by others, such use must be regulated in the national interest and in order to provide for the common defense and security and to protect the health and safety of the public . . .
>
> d. The processing and utilization of source, byproduct, and special nuclear material must be regulated in the national interest and in order to provide for the common defense and security and to protect the health and safety of the public . . .
>
> Sec. 3. Purpose.—It is the purpose of this Act to effectuate the policies set forth above by providing for— . . . .
>
> d. a program to encourage widespread participation in the development and utilization of atomic energy for peaceful purposes to the maximum extent consistent with the common defense and security and with the health and safety of the public . . .
>
> Sec. 29. Advisory Committee on Reactor Safeguards. —There is hereby established an Advisory Committee on Reactor Safeguards consisting of a maximum of fifteen members appointed by the Commission for terms of four years each. The Committee shall review safety studies and facility license applications referred to it and shall make reports thereon, shall advise the Commission with regard to the hazards of proposed or existing reactor facilities and the adequacy of proposed reactor safety standards, and shall perform such other duties as the Commission

may request. One member shall be designated by the Committee as its Chairman. The members of the Committee shall receive a per diem compensation for each day spent in meetings or conferences, or other work of the Committee, and all members shall receive their necessary traveling or other expenses while engaged in the work of the Committee. The provisions of section 163 shall be applicable to the Committee.

SEC. 104. MEDICAL THERAPY AND RESEARCH AND DEVELOPMENT.—

b. The Commission is authorized to issue licenses to persons applying therefor for utilization and production facilities involved in the conduct of research and development activities leading to the demonstration of the practical value of such facilities for industrial or commercial purposes. In issuing licenses under this subsection, the Commission shall impose the minimum amount of such regulations and terms of license as will permit the Commission to fulfill its obligations under this Act to promote the common defense and security and to protect the health and safety of the public and will be compatible with the regulations and terms of license which would apply in the event that a commercial license were later to be issued pursuant to section 103 for that type of facility. In issuing such licenses, priority shall be given to those activities which will, in the opinion of the Commission, lead to major advances in the application of atomic energy for industrial or commercial purposes.

"SEC. 161. GENERAL PROVISIONS.—In the performance of its functions the Commission is authorized to—

. . . . .

"i. prescribe such regulations or orders as it may deem necessary (1) to protect Restricted Data received by any person in connection with any activity authorized pursuant to this Act, (2) to guard against the loss or diversion of any special nuclear material acquired by any person pursuant to section 53 or pro-

duced by any person in connection with any activity authorized pursuant to this Act, and to prevent any use or disposition thereof which the Commission may determine to be inimical to the common defense and security, and (3) to govern any activity authorized pursuant to this Act, including standards and restrictions governing the design, location, and operation of facilities used in the conduct of such activity, in order to protect health and to minimize danger to life or property;

SEC. 182. LICENSE APPLICATIONS.—

a. Each application for a license hereunder shall be in writing and shall specifically state such information as the Commission, by rule or regulation, may determine to be necessary to decide such of the technical and financial qualifications of the applicant, the character of the applicant, the citizenship of the applicant, or any other qualifications of the applicant as the Commission may deem appropriate for the license. In connection with applications for licenses to operate production or utilization facilities, the applicant shall state such technical specifications, including information of the amount, kind, and source of special nuclear material required, the place of the use, the specific characteristics of the facility, and such other information as the Commission may, by rule or regulation, deem necessary in order to enable it to find that the utilization or production of special nuclear material will be in accord with the common defense and security and will provide adequate protection to the health and safety of the public. Such technical specifications shall be a part of any license issued. The Commission may at any time after the filing of the original application, and before the expiration of the license, require further written statements in order to enable the Commission to determine whether the application should be granted or denied or whether a license should be modified or revoked. All applications and statements shall be signed by the

applicant or licensee. Applications for, and statements made in connection with, licenses under sections 103 and 104 shall be made under oath or affirmation. The Commission may require any other applications or statements to be made under oath or affirmation.

"b. The Advisory Committee on Reactor Safeguards shall review each application under section 103 or 104 b. for a license for a facility, any application under section 104 c. for a testing facility, and any application under section 104 a. or c. specifically referred to it by the Commission, and shall submit a report thereon, which shall be made part of the record of the application and available to the public, except to the extent that security classification prevents disclosure.

SEC. 185. CONSTRUCTION PERMITS.—All applicants for licenses to construct or modify production or utilization facilities shall, if the application is otherwise acceptable to the Commission, be initially granted a construction permit. The construction permit shall state the earliest and latest dates for the completion of the construction or modification. Unless the construction or modification of the facility is completed by the completion date, the construction permit shall expire, and all rights thereunder be forfeited, unless upon good cause shown, the Commission extends the completion date. Upon the completion of the construction or modification of the facility, upon the filing of any additional information needed to bring the original application up to date, and upon finding that the facility authorized has been constructed and will operate in conformity with the application as amended and in conformity with the provisions of this Act and of the rules and regulations of the Commission, and in the absence of any good cause being shown to the Commission why the granting of a license would not be in accordance with the provisions of this Act, the Commission shall thereupon issue a license to the appli-

cant. For all other purposes of this Act, a construction permit is deemed to be a 'license'.

SEC. 189. HEARINGS AND JUDICIAL REVIEW.—

a. In any proceeding under this Act, for the granting, suspending, revoking, or amending of any license or construction permit, or application to transfer control, and in any proceedings for the issuance or modification of rules and regulations dealing with the activities of licensees, and in any proceeding for the payment of compensation, an award or royalties under sections 153, 157, 186 c., or 188, the Commission shall grant a hearing upon the request of any person whose interest may be affected by the proceeding, and shall admit any such person as a party to such proceeding. The Commission shall hold a hearing after thirty days' notice and publication once in the Federal Register on each application under section 103 or 104 b. for a license for a facility, and on any application under section 104 c. for a license for a testing facility. . .

SEC. 261. APPROPRIATIONS.—

a. There are hereby authorized to be appropriated such sums as may be necessary and appropriate to carry out the provisions and purposes of this Act, except— . . .

(2) Such as may be necessary to carry out cooperative programs with persons for the development and construction of reactors for the demonstration of their use, in whole or in part, in the production of electric power or process heat, or for propulsion, or solely or principally for the commercial provision of byproduct material, irradiation, or other special services, for civilian use, by arrangements (including contracts, agreements, and loans) or amendments thereto, providing for the payment of funds, the rendering of services, and the undertaking of research and development without full reimbursement, the waiver of charges accompanying such arrangement, or the provision by the Commission of any other financial

assistance pursuant to such arrangement, or which involves the acquisition or condemnation of any real property or any facility or for plant or facility acquisition, construction or expansion undertaken by the Commission as a part of such arrangements.

2. The regulations of the Atomic Energy Commission, 10 CFR, provide in part:

Sec. 50.34 Contents of applications; technical information hazards summary report. Each application shall state the following technical information:

(a) A description of the chemical, physical, metallurgical, or nuclear process to be performed, and a statement of the kind and quantity of any radioactive effluent expected to result from the process. The description of the process should be sufficiently detailed to permit evaluation of the radioactive hazards involved. The magnitude of the proposed operation should be indicated in terms of the amount and radioactivity of source, special nuclear, or by-product material to be handled per unit of time, and thermal power to be generated if any.

(b) A description of the facility. The description should be based on the design criteria for the facility as a whole and for those major component parts which are essential to the safe operation of the facility, and should be presented in sufficient detail to allow an evaluation of the adequacy of the various means proposed to minimize the probability of danger from radioactivity to persons both on and off-site. The description should also cover any activities, other than those subject to license, proposed to be carried on in the building which will house the facility and on the balance of the site.

(c) A description of the site on which the facility is to be located. This should include a map of the area showing the location of the site and indicating the use to which the surrounding land is put, i. e., industrial; commercial, agricultural, residential; loca-

tion of sources of potable or industrial water supply, watershed areas and public utilities; and a scale plot plan of the site showing the proposed location of the facility.

(d) A description of proposed procedures for: routine and non-routine operations, start-up and shutdown, maintenance, storage, training of employees, minimizing operational mishaps (such as locked controls, check-lists, and close supervision), investigating unusual or unexpected incidents; and a description of such other details as may be useful in evaluating the existence and effectiveness of safeguards against the radioactive hazards in the operation of the facility.

(e) A description of plans or proposals in the event that acts or accidents occur which would create radioactive hazards. The description should relate the various operational procedures, the protective devices, and the pertinent features of the site, to such happenings as operational mistakes, equipment or instrument failure or malfunction, fire, electric power failure, flood, earthquake, storm, strike, and riot.

(f) Meteorological, hydrological, geological, and seismological data necessary for evaluating the measures proposed for protecting the public against possible radioactive hazards.

(g) An evaluation of the proposed measures and devices to prevent acts or accidents which would create radioactive hazards or to protect against the consequences should such acts or accidents occur.

(h) A description of procedures for disposal of radioactive solid waste and the final disposal of liquid waste effluent.

(i) A description of means provided to sample atmosphere discharges through stacks where such stacks may emit by-product material or special nuclear material

Sec. 50.35 Extended time for providing technical information. Where, because of the nature of a proposed project, an applicant is not in a position to

supply initially all of the technical information otherwise required to complete the application, he shall indicate the reason, the items or kinds of information omitted, and the approximate times when such data will be produced. If the Commission is satisfied that it has information sufficient to provide reasonable assurance that a facility of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public and that the omitted information will be supplied, it may process the application and issue a construction permit on a provisional basis without the omitted information subject to its later production and an evaluation by the Commission that the final design provides reasonable assurance that the health and safety of the public will not be endangered.

Sec. 50.40 Common standards. In determining that a license will be issued to an applicant, the Commission will be guided by the following considerations:

(a) The processes to be performed, the operating procedures, the facility and equipment, the use of the facility, and other technical specifications, or the proposals in regard to any of the foregoing collectively provide reasonable assurance that the applicant will comply with the regulations in this chapter, including the regulations in Part 20, and that the health and safety of the public will not be endangered.

(b) The applicant is technically and financially qualified to engage in the proposed activities in accordance with the regulations in this Chapter.

(c) The issuance of a license to the applicant will not, in the opinion of the Commission, be inimical to the common defense and security or to the health and safety of the public.

Sec. 50.56 Conversion of construction permit to license or amendment of license. Upon completion of the construction or alteration of a facility, in compliance with the terms and conditions of the construction

permit and subject to any necessary testing of the facility for health or safety purposes, the Commission will, in the absence of good cause shown to the contrary issue a license of the class for which the construction permit was issued or an appropriate amendment of the license, as the case may be.

APPENDIX B

(10 CFR Part 50)

LICENSING OF PRODUCTION AND UTILIZATION FACILITIES

Notice of Proposed Rule Making

At the present stage of development of nuclear reactors, most new facilities incorporate features having varying degrees of advanced technology. Usually in these cases substantial research and development effort is needed to prove out the feasibility of major features or components of the project. Under the proposed amendments, the Commission may issue construction permits on the basis of site approval for a facility of the size and general design concepts proposed even though there are major features or components with respect to which necessary safety determinations cannot then be made. The Commission will not be required to make a judgment as to the probable results of research and development programs to resolve the undetermined safety questions. The applicant will be on notice as to the features for which safety approval is withheld at the time of issuance of the construction permit. It will be permissible for him to start construction after he has obtained this site approval and he may thereafter obtain approval of design details and specifications by amendment to his provisional construction permit as the work progresses.

Notice is hereby given that adoption of the following amendment is contemplated. All interested persons who desire to submit written comments and suggestions for consideration in connection with the proposed amendments should send them to the United States Atomic Energy Commission, Washington 25, D. C., Attention: Director, Division of Licensing and Regulation, within 60 days after publication of this notice in the FEDERAL REGISTER.

Section 50.35 is amended to read as follows:

50.35 Issuance of construction permits.

(a) Where, because of the nature of a proposed project, an applicant is not in a position to supply initially all

of the technical information required to support the issuance of a construction permit which approves all proposed design features, the Commission may nevertheless issue a construction permit if it finds that there is reasonable assurance that the proposed location is suitable from a safety standpoint for a facility of the size (power level in the case of reactors) and general design concept proposed, that the applicant has identified any major features or components on which further research and development work is needed to determine their acceptability from a safety standpoint, and that the applicant will conduct a research and development program which will investigate the unresolved safety questions.

(b) A construction permit will constitute an authorization to the applicant to proceed with construction but will not constitute Commission safety approval of any design feature, or specification unless the applicant specifically requests such approval and such approval is incorporated in the permit. The applicant, at his option, may request such approvals in the initial construction permit or, from time to time, by amendment to his construction permit.

(c) Except to the extent that approval of design features or specifications has been incorporated in the permit, any construction permit will be subject to the limitation that a license authorizing operation of the facility will not be issued by the Commission until the applicant has submitted to the Commission (by amendment to the application) the complete final hazards summary report (portions of which may be submitted and evaluated from time to time), and the Commission has found that the final design provides reasonable assurance that the health and safety of the public will not be endangered by operation of the facility in accordance with the procedures, limitations and conditions specified in the final hazards summary report.

Dated at Germantown, Md., this 5th day of February 1960.

For the Atomic Energy Commission

A. R. Luedecke,
General Manager.

APPENDIX C

CONSTRUCTION PERMITS ISSUED BY ATOMIC ENERGY COMMISSION[1]

I. *Power Reactors*

CPPR-1	Consolidated Edison Co.	21 F.R. 3084	5/9/56
CPPR-2	Commonwealth Edison Co.	21 F.R. 3085	5/9/56
CPPR-3	General Electric Company	21 F.R. 3395	5/22/56
CPPR-4	*Power Reactor Development Co.*	21 F.R. 5974	8/9/56
CPPR-5	Yankee Atomic Electric Co.	22 F.R. 7188	
		22 F.R. 9237	11/19/57
CPPR-6	Saxton Nuclear Experimental Corp. Associates, Inc.	24 F.R. 9244	
		25 F.R. 1471	2/18/60
CPPR-7	Carolinas Virginia Nuclear Power Associates, Inc.	25 F.R. 522	
		25 F.R. 4206	5/11/60
CPPR-8	Northern States Power Company	25 F.R. 254	
		25 F.R. 4484	5/20/60
CPPR-9	Consumers Power Company	25 F.R. 1699	
		25 F.R. 5002	6/7/60

II. *Research and Development Reactors*

CPRR-1	University of Michigan[2]		2/17/55
CPRR-2	Armour Research Foundation[3]		6/12/56
CPRR-3	U.S. Naval Research Lab.[3]		4/29/55
CPRR-4	Battelle Memorial Institute[3]		5/4/55
CPRR-5	Massachusetts Institute of Technology[3]		5/7/55
CPRR-6	Aerojet-General Nucleonics	21 F.R. 6520	8/29/56
CPRR-7	Industrial Reactor Lab. Inc.	22 F.R. 618	1/30/57
CPRR-8	Westinghouse Electric Corp.	22 F.R. 152	
		22 F.R. 4891	7/11/57
CPRR-9	Aerojet-General Nucleonics	22 F.R. 742	
		22 F.R. 1321	3/2/57
CPRR-10	North Carolina State College	22 F.R. 1052	
		22 F.R. 1616	3/13/57
CPRR-11	Curtiss Wright Corp.	22 F.R. 3902	
		22 F.R. 4316	6/27/57
CPRR-12	Aerojet-General Nucleonics	22 F.R. 4327	
		22 F.R. 4919	7/12/57
CPRR-13	Aerojet-General Corp. & Aerojet Gen. Nucl.	22 F.R. 4329	
		22 F.R. 4919	7/12/57
CPRR-14	North American Aviation, Inc.	22 F.R. 5648	
		22 F.R. 6367	8/8/57

[1] List of permits is same as that presented to court of appeals.

[2] Where there are two F.R. citations for an application, the first contains the notice of intention to issue a construction permit, generally including all findings of fact, and the second contains notice of issuance of permit. Dates given are dates of publication of notice of issuance of permit.

[3] Not published in Federal Register. Date given is date of issuance of permit.

PRR 15	University of Virginia	22 F.R. 6978			
		22 F.R. 7494	9	19	57
PRR 16	Ordnance Materials Research Office	22 F.R. 7410			
		22 F.R. 8020	10	9	57
PRR-17	Daystrom, Inc.	22 F.R. 7667			
		22 F.R. 8424	10	25	57
PRR-18	Union Carbide Corp.	22 F.R. 7916			
		22 F.R. 9005	11	9	57
PRR 19	General Electric Co.	22 F.R. 8049			
		22 F.R. 8855	11	2	57
PRR 20	American Radiator and Standard Sanitary Corp.	22 F.R. 8189			
		22 F.R. 8964	11	7	57
PRR 21	University of Florida	22 F.R. 9732			
		22 F.R. 29	1	1	58
PRR-22	Aerojet-General Nucleonics	23 F.R. 168			
		23 F.R. 690	2	1	58
PRR-23	Aerojet-General Nucleonics	23 F.R. 689			
		23 F.R. 1279	3	1	58
PRR-24	Aerojet-General Nucleonics	23 F.R. 725			
		23 F.R. 1279	3	1	58
PRR-25	General Dynamics Corp.	23 F.R. 2462			
		23 F.R. 3107	5	9	58
PRR-26	North American Aviation, Inc.	23 F.R. 2991			
		23 F.R. 3581	5	23	58
PRR-27	Aerojet-General Nucleonics	23 F.R. 5551			
		23 F.R. 6489	8	12	58
PRR-28	Babcock and Wilcox Co.	23 F.R. 6380			
		23 F.R. 7089	9	12	58
PRR-29	Nuclear Development Corp. of Amer.	23 F.R. 7332			
		23 F.R. 7934	10	14	58
PRR-30	University of Arizona	23 F.R. 8681			
		23 F.R. 9270	11	29	58
PRR-31	Cornell University	23 F.R. 8681			
		23 F.R. 9270	11	29	58
PRR-32	North Carolina State College	23 F.R. 8769			
		23 F.R. 9655	12	3	58
PRR-33	University of Wyoming	24 F.R. 951			
		24 F.R. 1964	3	5	59
PRR-34	North Carolina State College	24 F.R. 1575			
		24 F.R. 2317	3	25	59
PRR-35	West Virginia University	24 F.R. 4569			
		24 F.R. 5255	6	27	59
PRR-36	Veterans Administration Hospital	24 F.R. 4671			
		24 F.R. 5347	7	1	59
PRR-37	State College of Washington	24 F.R. 5121			
		24 F.R. 5696	7	15	59
PRR-38	Texas Agricultural and Mechanical College Sys.	24 F.R. 5744			
		24 F.R. 6441	8	11	59

CPRR–39	University of Buffalo	24 F.R. 7045 24 F.R. 7625 9 22
CPRR–40	University of Washington	24 F.R. 7797 24 F.R. 8469 10 20
CPRR–41	Iowa State University	24 F.R. 7741 24 F.R. 8468 10 20
CPRR–42	University of California	24 F.R. 8468 24 F.R. 9409 11 21
CPRR–43	Virginia Polytechnic Institute	24 F.R. 8660 24 F.R. 9409 11 21
CPRR–44	Curators of University of Missouri, School of Mines and Metallurgy	24 F.R. 9028 24 F.R. 9556 11 28
CPRR–45	Worcester Polytechnic Institute	24 F.R. 9064 24 F.R. 9590 12 1
CPRR–46	Board of Trustees of Leland Stanford Junior University	24 F.R. 9027 24 F.R. 9556 11 28
CPRR–47	Naval Research Laboratory	24 F.R. 9027 24 F.R. 9557 11 28
CPRR–48	Walter Reed Army Institute of Research	24 F.R. 10322 24 F.R. 255 1 13
CPRR–49	Ohio State University	25 F.R. 415 25 F.R. 1140 2 9
CPRR–50	American Radiator and Standard Sanitary Corp.	25 F.R. 1968 3 5
CPRR–51	University of Illinois	25 F.R. 2369 25 F.R. 3118 4 12
CPRR–52	University of Kansas	25 F.R. 2465 25 F.R. 3200 4 15
CPRR–53	University of Maryland	25 F.R. 5253 25 F.R. 6374 7 7
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CPRR–58	Cornell University	25 F.R. 5191 25 F.R. 6372 7 7

APPENDIX D

List of Reported Atomic Reactor Accidents

Reactors in United States

Date	Reactor and Location	Type of Accident	Reference
1961			
Jan. 3	SL-1 Arco, Idaho	Explosion	Report on SL-1 AEC General Manager Board of Investigation
1960			
Nov. 15	Dresden, Ill.	Control rod failure	AEC Docket No. 50-10
Apr. 3	WTR Waltz Mill, Pa.	Fuel element failure	*Nucleonics Week* 4/14/60:3
March 10	GETR Pleasanton, Cal.	Fuel element release	*Annual Report* AEC, 1960 p. 279
Feb.	HRE-2 Oak Ridge, Tenn.	Corrosion hole in core tank	*Nucleonics Week*, 2/18/60:3
1959			
July 24	SRE Santa Susana, Cal.	Fuel element failure	*Nuclear Safety*, AEC. 3/60:73
1958			
Nov. 18	ANP Idaho Falls, Id.	Release	*Oak Ridger*, Oak Ridge, Tenn. 12/1/58
Apr. 4	HRE-2 Oak Ridge, Tenn.	Leak in core tank	*Semi-Annual Report*, AEC. July-Dec. 1958, p. 32
1957			
Oct. 12	Godiva Los Alamos, N.M.	Godiva explosion	22nd Semi-Annual Report AEC, July 1957. p. 66.
Jan. 4	KEWB Santa Susana, Cal.	Pump failure	*Radiation Hazards, etc.* Joint Committee on Atomic Energy, 86th Cong. 1st Session, Feb. 1959, p. 314.
1956			
Nov.	HRE-2 Oak Ridge, Tenn.	Corrosion	*Oak Ridger*, Oak Ridge, Tenn. 12/21/56.
Sept. 6	Seawolf Groton, Conn.	Sodium corrosion	*21st Semi-Annual Report* AEC. Jan. 1957, p. 50.

Date	Reactor and Location	Type of Accident	Reference
1956			
July 23	MTR Idaho Falls, Id.	Refueling exposures	*Radiation Hazards*, etc. Joint Committee on Atomic Energy, 86th Cong. 1st Session, Feb. 1959, p. 96.
1955			
Nov. 29	EBR-1 Arco, Id.	Meltdown	Argonne National Laboratory, Report 57 AEC, November 1957
Nov. 1	PR Hanford, Wash.	Fire in reactor slug	TID-5360, AEC August 1956, p. 47.
May	RRR Raleigh, N.C.		TID-5360, AEC August 1956, p. 28.
1954			
June	MTR Arco, Idaho	Fuel plate melting	Proceedings of 1st United Nations Conference on Peaceful Uses of Atomic Energy, Vol. 11, p. 276.
Feb. 3	Godiva Los Alamos, N.M.	Burst causes disassembly	TID 5360, AEC August 1956. 9
1952			
June 2	CP Lemont, Ill.	Loss of moderator	Ibid. p. 23
June 2	Clementine Los Alamos, N.M.	Ruptured fuel element	PRDC Tr. 4078 Testimony of W. K. Davis
1949			
Dec.	Los Alamos, N.M.	Super-criticality	*Radiation Hazards*, etc. Joint Committee on Atomic Energy, 86th Cong. 1st Session. Feb. 1959, p. 96.
1947-1948	GR Oak Ridge National Laboratory, Oak Ridge, Tenn.	Fuel element failure	Proceedings of 1st United Nations Conference, etc. Vol. 11, p. 286.

II. *Reactors in Foreign Countries.*

Date	Reactor and Location	Type of Accident	Reference
1960			
July 6	G–2 Marcoule, France	Fuel canal rupture	*Nucleonics Week* 7/14/60:5
March	Teakettle W. Berlin, Germany	Research reactor breakdown	*Nucleonics Week* 4/14/60:5
1959			
Dec. 19	JRR–I Tokai, Mura, Japan	Release	*Nucleonics Magazine* 2/60:26
Nov. 10	AGN–211 Basle, Switzerland	Scram malfunction	AEC Docket No. 50–88; 50–103 ltrs. dated 5/6/60, 8/18/60, 8/25/60.
Feb. 16	EL–2 Saclay, France	Fuel element rupture	*Nucleonics Magazine* 3/60:85
1958			
Dec. 27	EL–2 Saclay, France	Fuel element failure	*Nucleonics Magazine* 3/60:85
Oct. 15	ZER Vinca, Yugoslavia	Power surge	*Nuclear Safety* AEC, Sept. 1959, p. 38.
June 28	Calder Hall, Calder Hall, England	Turbine failure	*ATOM* 8/58:8 Bulletin of United Kingdom Atomic Energy Authority.
May 23	NRU Chalk River, Canada	Power burst	*Nuclear Safety*, AEC 3/60: 82ff
April 13	EL–3 Saclay, France	Fuel element failure	*Nucleonics Magazine* 3/60:82ff
1957			
Dec.	Saphir Wurenlingen, Switzerland	Air pollution	Proceedings of 2nd United Nations Conference, etc. Vol. 10, p. 192.
Nov. 26	EL–2 Saclay, France	Converter meltdown	*Nucleonics Magazine* 3/60:82ff
Oct. 10	Windscale # 1 Windscale, England	Burning fuel elements	*Nuclear Safety*, AEC 12/59:55
1956			
Oct. 26	G–1 Marcoule, France	Fuel Ele. partial burn.	Proceedings of 2nd United Nations Conference, etc. Vol. 9, p. 490.

Date	Reactor and Location	Type of Accident	Reference
1955			
Feb.	JEEP Kjeller, Norway	Uranium Oxidized	Proceedings of 1st United Nations Conference, etc. Vol. 11, p. 262.
1954			
July	Windscale # 1 Windscale, England	Spontaneous energy release	Proceeding of 2nd United Nations Conference, etc., Vol. 10, p. 500.
1953	HWRR Soviet Union	Uranium rod covering failure	Proceedings of 1st United Nations Conference, etc. Vol. 11, p. 428.
1952			
Dec. 12	NRX Chalk River, Canada	Power surge	*Engineering Journal* Engineering Institute of Canada, 10/53
September	Windscale # 1 Windscale, England	Accidental release	CMND. 471, 7/58 Atomic Energy Office Report, July 1958

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In The

Supreme Court of the United States

October Term, 1960

No. 315 and 454

Power Reactor Development Company, *Petitioner*,

v.

International Union of Electrical, Radio and Machine Workers, AFL-CIO, et al., *Respondents*.

United States of America and Atomic Energy Commission, *Petitioners*,

v.

International Union of Electrical, Radio and Machine Workers, AFL-CIO, et al., *Respondents*.

On Writs of Certiorari to the United States Court of Appeals For the District of Columbia Circuit

MOTION OF ADOLPH J. ACKERMAN, FOR LEAVE TO FILE BRIEF AS AMICUS CURIAE

ADOLPH J. ACKERMAN
Consulting Engineer
1250 Sherman Avenue
Madison 3, Wisconsin

Of Counsel:

R. M. STROUD
1 West Main Street
Madison 3, Wisconsin

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On Writs of Certiorari to the United States Court of Appeals For the District of Columbia Circuit

MOTION OF ADOLPH J. ACKERMAN, FOR LEAVE TO FILE BRIEF AS AMICUS CURIAE

1. Adolph J. Ackerman, an American citizen, and a consulting engineer resident in Madison, Wisconsin, respectfully moves this Court for leave to file a brief in this case as *amicus curiae*, the parties to the case having refused to give their consent to the filing of such a brief.

2. The applicant's interest in the present case is based on the fact that the traditional responsibilities of the engineering profession are being invaded and displaced. He considers it his professional responsibility and duty to bring these matters to the attention of this Court.

3. The applicant is an independent consulting engineer engaged in the practice of professional engineering in the field of electric power and water resources development. This includes the economic appraisal of proposed progfams of development and the general planning and site selection for new power plants. He began his formal professional practice in 1937 under a license granted by the State of Tennessee, and he has been licensed to practice in various other states. Part of his time is devoted to the educational field in professional engineering as a Visiting Professor and as a member of a Visiting Committee at two leading universities. He has served on various committees of National Engineering Societies which have been concerned with the practical application of atomic energy.

4. The issues before the Court in this proceeding are of grave importance in the application of the new science of atomic energy for the generation of electricity, and involve heavy responsibilties concerning the health and safety of the general public. Beyond the questions which have been defined in terms of embryonic law and emerging regulatory principles, is the fundamental question whether a potential hazard of unprecedented magnitude shall be introduced in an area where a large population would be exposed to it. The Court's decision in this case is bound to have direct and far-reaching influence on the progress

and application of atomic power and on the related questions of public health and safety.

5. The selection of a site for an atomic power plant is not governed by rules of law, but calls for the application of expert judgment by professional engineers. It is a problem involving great responsibility and technical complexity on which the available knowledge is relatively limited.

6. Although the criteria for the selection of a site for a conventional type of power plant correspond to well established principles based on the operating experiences of many similar power plants in all parts of the country, the introduction of atomic energy for the generation of electricity has brought with it new criteria for site selection. The applicant will show that some of the criteria employed in the selection of the site for the atomic power plant in the instant case violate the established principles of responsibility which the engineering profession is expected to observe. The basic issue, therefore, although it here concerns specific parties, is of deep concern—now and for all future time—to professional engineers.

7. The violation of the established principles of responsibility of the engineering profession has resulted in creating a potential hazard which has been evaluated in a study released by the Atomic Energy Commission. This study revealed that property damage from the failure of an atomic power plant could amount to more than $2,000,000,000, that fatalities could number in the thousands, and injuries in the tens of thousands. The insurance industry sought to serve this new area of risk-taking but found it beyond its capabilities. It must be viewed with regret that

this problem has been resolved by placing on the Federal Government, and, thus, on the nation's taxpayers, the liability for any damage (in excess of a relatively small amount covered by the insurance companies) which might result from an atomic power plant disaster.

8. It is the belief of the applicant that an exposition on the responsibilities of the professional engineer in relationship to the tremendous perils involved in the application of the new atomic science will help to clarify the fundamental questions before the Court.

9. The applicant has reviewed the briefs filed by the parties to the case and has not found therein any discussion on these points, and applicant has no reason to believe that the argument of these points will be expanded and made complete in this Court. Because the present case represents the first in which the regulatory activities of the Atomic Energy Commission have been challenged before this Court, the applicant believes that, unless the facts as set forth in his brief are brought to the attention of the Court for its consideration, the Court may unintentionally approve of procedures which invade and interfere with the responsibilities of the professional engineer, to the detriment of the health and welfare of the public.

ADOLPH J. ACKERMAN
Consulting Engineer
1250 Sherman Avenue
Madison 3, Wisconsin

Of Counsel:

R. M. STROUD
1 West Main Street
Madison 3, Wisconsin

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Supreme Court of the United States

REPLY BRIEF FOR PETITIONER POWER REACTOR DEVELOPMENT COMPANY

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Supreme Court of the United States

OCTOBER TERM, 1960

No. 315

POWER REACTOR DEVELOPMENT COMPANY, *Petitioner,*

v.

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL-CIO, *et al., Respondents*

ON WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

REPLY BRIEF FOR PETITIONER POWER REACTOR DEVELOPMENT COMPANY

Before turning to the principal contentions urged in respondents' brief, it may be helpful to clarify the questions now actually before the Court by a preliminary reference to some matters that are *not* in issue here.

First, there is not now any issue between the parties with respect to the second question presented in the briefs of petitioners here and in No. 454 of whether the statute requires the Commission to make a finding of "compelling reasons" to justify the location of this or any other large power reactor at a site in a comparably populated area. Respondents apparently do not challenge the position taken by petitioners on this question but urge merely that the court below did not intend to hold to the contrary (br. pp. 27-28, 82-88). While we think the majority opinion of the court below speaks for itself on this, it would certainly not be profitable to discuss further just what that court did mean to hold.

Second, it should be emphasized again that there is not presented here the ultimate question of whether this reactor can be safely operated. That question, as the provisional construction permit itself (R. 718) and the Commission's opinion and findings (R. 711-12) made abundantly clear, is to be the subject of a future public report by the Advisory Committee on Reactor Safeguards in accordance with Section 182 b of the Act, followed by a further public hearing on evidence to be adduced before a hearing examiner, and his decision on the record then made will be subject to review by the Commission and the courts under Section 189.

On this point, all agree and have agreed from the inception of this project that, before this or any other reactor is permitted to be operated, such operation must be shown to be sufficiently safe to meet the strict statutory standard of adequate protection to the health and safety of the public. All agree, also, that, in determining the extent of such protection required, there must be considered both the magnitude of the potential damage involved, taking into full consideration the reactor's location, and the degree of improbability that any such damage can occur in the light of the technical design features of the reactor as completed and the other protective measures provided. That public safety is the overriding consideration was recognized by PRDC in testimony submitted in January, 1957, on the opening day of the hearing in this proceeding (R. 728-30). It was recognized by the Commission in its decision when it said that "There can be no doubt that public safety is the first, last, and a permanent consideration in any decision on the issuance of a construction permit or a license to operate a nuclear facility" (R. 646-47). It has similarly been recognized by the Solicitor General throughout his brief in this Court. The suggestion in respondents' brief (p. 29) that petitioners are attempting to temper this concern for health and safety by "considerations of expediency" is wholly unjustified.

By a number of inaccurate and misleading statements, respondents have sought further to create the impression that the general reactor safety record to date has been poor,

that precautions taken to protect the public are essentially inadequate, and that the particular reactor involved here is especially dangerous and still presents substantial unresolved safety questions. None of this is the fact. While it would be neither practicable nor profitable to attempt to refute all of the erroneous statements and innuendoes with which respondents' brief bristles, we have believed it worth while to lay to rest these serious charges. See Point III, pp. 30-33, below.

We turn now to a consideration of the positions taken by respondents in their brief on the various aspects of the questions which we believe are presented here. While not all of these positions are either clear or consistent, it is believed that the following is a fair distillation of the more important contentions advanced, in the order in which we shall deal with them in this reply brief:

With respect to the first question presented, the basic position urged by respondents is that the court below was right in holding that the Commission does not have the statutory authority or discretion to issue construction permits on a provisional basis without positive findings that the reactor can be operated safely upon its completion. The core of respondents' argument is that the Commission is required to make essentially the same safety finding before it authorizes construction of a reactor that is needed to permit its later proposed operation. Surprisingly, however, they also take the position that "neither the Act, nor the Commission's regulations, *require* a construction permit for the building of a reactor, up to the point special nuclear materials are used" (br. pp. 47-48). If this is really so, of course, this entire proceeding has been an unnecessary and expensive farce. How respondents can seriously argue that the provisional construction permit must be set aside because the overriding Congressional concern for public safety requires a definitive safety determination before construction is permitted to begin on the one hand, and yet urge that the statute, properly construed, does not require a construction permit at all until the

reactor has been completed to the point where it is ready to receive nuclear material on the other, is difficult to understand.[1]

Passing this paradox, however, respondents proceed to urge that the Act and its legislative history support their primary contention that the statute forbids issuance of provisional construction permits without positive findings with respect to safety of operation (Points I A, B, pp. 30-44). Respondents also urge that the Commission's own regulations require the same conclusion, that in all cases except this one they have been so construed and applied, and that here its findings were uniquely deficient and satisfied neither the statute nor the regulations (Points I C, E, pp. 45-58, 65-79). Finally, respondents urge that Congress has rejected rather than acquiesced in what we believe to be the Commission's consistent interpretation of the statute and its practice with respect to provisional construction permits (Point I D, pp. 58-64).

With respect to the second question presented, respondents apparently do not disagree with the position of petitioners that the statute does not require the Commission to find "compelling reasons" to justify the location of any large power reactor at a site having a population distribution around it comparable to that found here, but they urge, nevertheless, that the Commission's findings with respect to site were deficient and that it failed to give any

---

[1] The construction permit here as in other cases provides that "the term 'completion date' as used herein means the date on which construction of the reactor is completed except for the introduction of the fuel material" (R. 716).

Section 101 of the Act requires a license to "manufacture" or "produce" a reactor ("utilization or production facility"). Although this provision has always been generally recognized to be applicable to construction of a reactor, there was until the promulgation of Section 50.10(b) of the regulations in early 1960 a considerable question as to just how far one could go before having to obtain a construction permit (10 C.F.R., 1961 Supp., Appendix p. 35, below). The stage at which a construction permit is required is now precisely defined in that regulation.

consideration to the question of the population distribution (Point II, pp. 82-90).

In this reply brief, we shall deal with each of these aspects of respondents' argument.

I

THE COMMISSION'S SAFETY FINDINGS MET THE REQUIREMENTS OF THE STATUTE AND THE REGULATIONS

The basic question presented here is one of statutory interpretation. Respondents emphasize that the Atomic Energy Act of 1954 requires the Commission to give overriding effect to the protection of the health and safety of the public. They urge that the statute, and particularly the language contained in Sections 182 a and 185, requires the Commission to make a positive finding before issuing a construction permit that the reactor can be operated safely at its proposed location (br. pp. 30-39).

A. CONGRESS INTENDED TO GIVE THE COMMISSION BROAD DISCRETION IN REGULATING THE INDUSTRY SO AS TO PROTECT PUBLIC HEALTH AND SAFETY WHILE PERMITTING AND ENCOURAGING MAXIMUM NUCLEAR PROGRESS

1. There is no disagreement here that Congress imposed on the Commission the obligation to regulate this entirely new atomic energy industry so as "to provide for the common defense and security and to protect the health and safety of the public" (*e.g.*, Section 2 d, Govt. Main Brief Appendix A, p. 92). In erecting the licensing framework within which the Commission was to work in implementing this and the other basic statutory policies, Congress could have chosen either to establish a series of specific safety findings required to be made at each stage of the licensing proceeding, or to delegate to the Commission a broad authority to prescribe by regulation such findings as it deemed appropriate to carry out its statutory obligations, including the obligation to provide adequate protection to the public health and safety.

Recognizing the novelty and technical complexity of this new field, Congress wisely chose the latter approach. It gave the Commission in Section 161 i the broad authority to

> "prescribe such regulations or orders as it may deem necessary . . .(3) to govern any activity authorized pursuant to this Act, including standards and restrictions governing the design, location and operation of facilities used in the conduct of such activity, in order to protect health and to minimize danger to life or property" (Govt. Main Brief Appendix A, p. 116).

The substantive licensing provisions covering research and developmental reactors are contained in Section 104. Subparagraph b of Section 104, specifically applicable to demonstration reactors of the type involved here, recognizes the Commission's basic safety responsibility by providing that in issuing licenses thereunder the Commission "shall impose the minimum amount of such regulations and terms of license as will permit the Commission to fulfill its obligations under this Act to promote the common defense and security and to protect the health and safety of the public. . . ." Subparagraph d of Section 104 further provides that no "license" (which includes construction permit in this context) may be issued under that section "if, in the opinion of the Commission, the issuance of a license to such person would be inimical to the common defense and security or to the health and safety of the public" (Govt. Main Brief Appendix A, pp. 111-12).[2] The Commission here as in other construction permit decisions made the finding called for by this provision. See Finding 35, R. 711.

These provisions implement and are fully consistent with the Congressional purpose to give the Commission the broadest authority in determining just what further

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[2] To the same effect, see also Section 50.40(c) of the Commission's regulations (10 C.F.R.), Appendix pp. 35-36, below. See also pp. 16-17, below.

determinations at different stages of the licensing procedure are necessary and appropriate to provide adequate protection to the public safety, and at the same time to further the Congressional policy to promote the rapid development of those reactor concepts which will, as Section 104 b also states, "lead to major advances in the application of atomic energy for industrial or commercial purposes".

As pointed out in our main brief (pp. 26-30), nothing in the language of Section 185, providing for the issuance of construction permits generally, or of Section 182 a, dealing with the type of information to be included in applications for licenses, including in terms "licenses to operate" reactors, is inconsistent with this broad delegation of authority to the Commission to devise practicable licensing procedures. The procedures established by the Commission pursuant to this authority provide fully for the protection of the public health and safety, and do so in a way which encourages the maximum progress in the application of atomic energy to peaceful uses. Plainly Congress intended the Commission to accomplish both of these objectives.

2. In our main brief (pp. 26-27, 37-47) we have analyzed the principal aspects of the Act's legislative history, including the colloquy between Senators Hickenlooper and Humphrey relied upon by the court below and respondents here. Respondents have simply ignored our analysis of the background to this colloquy (main brief, pp. 40-46), without which its significance cannot be understood. Indeed, in quoting the colloquy respondents have actually omitted that portion in which Senator Humphrey refers to the notice provisions of Section 182 and which illustrates that his concern was with these and related procedural aspects of that section. (Compare partial quotation in respondents' brief, pp. 41-42 with full quotation in our main brief, p. 39, n. 25.)

Respondents further urge, however, that an exchange between an industry spokesman, Mr. Paul McQuillen, and Chairman Cole at the hearings on the bill in 1954 independently indicates the latter's agreement to the proposition

that the Act as passed requires positive safety findings at the construction permit stage. In quoting this exchange, however, respondents omit a statement immediately preceding Mr. Cole's quoted interjection (br. pp. 39-40, n. 23) which indicates that he may have been referring primarily to another question raised by the witness—whether various activities requiring different licenses can be consolidated in a single license. See *Hearings Before the Joint Committee on Atomic Energy on S. 3323 and H. R. 8862*, 83d Cong., 2d Sess. (1954), p. 119, II *Legis. Hist.* 1753; *cf.* Section 161 h, first included in the bill after the conclusion of the hearings in question (I *Legis. Hist.* 645, 718). In any event, there is nothing whatever in the testimony of Mr. McQuillen or the comments of the Committee members that indicates that the former desired or the latter intended the bill to deprive the Commission of authority in appropriate cases to issue construction permits "on a provisional basis". On the contrary, Mr. McQuillen and certain other industry witnesses, with the problems presented by the financing of large commercial reactor projects primarily in mind,[3] merely wanted assurance that in such cases conversion of construction permits to operating licenses could be relatively automatic, and that in any event the construction permit holder would know in advance what he would have to do to obtain an operating license. In fact, in his statements (not quoted by respondents) following those of Chairman Cole he suggested that Section 185 would need amendment fully to accomplish his objectives, thus recognizing that the section as drafted (and later enacted) would not provide the kind of assurances he wished to have available for appropriate cases.

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[3] *See Hearings, supra*, pp. 114, 118, 119-20, 226-27, 417, II *Legis. Hist.* 1748, 1752, 1753-54, 1860-61, 2051.

B. THE COMMISSION'S LICENSING PROCEDURES ARE GEARED TO THE PRACTICAL PROBLEMS PRESENTED BY CONSTRUCTION, START-UP, AND OPERATION OF VARIOUS CLASSES OF REACTORS

Respondents urge vigorously that the Commission's own regulations, properly interpreted, require in all cases a positive finding that the proposed reactor can be safely operated at its location—presumably at its proposed full power—before any kind of construction permit can be granted. Such an interpretation would destroy the whole step-by-step licensing procedure which these regulations are designed to establish and which, contrary to respondent's further contention, the Commission has used in licensing developmental power reactors (pp. 17-19, below). A review of the licensing system so established and its relationship to the present state of development of reactor technology provides the most effective refutation to this argument.

The Commission's regulations provide two procedures for the licensing of nuclear reactors—one applicable to standardized, fully proven types, and one to more advanced or developmental types. Each of these approaches is designed, as it must be, to deal with the technical and practical problems which the particular type of project presents. Each approach provides in full measure for adequate protection to the health and safety of the public.

As the Commission pointed out in its opinion (R. 649), it is already true today that a number of the many small research reactors licensed for construction and operation by educational institutions and others are "of standard types, which have become virtually production line items." Since all relevant technical information on such standardized reactor designs is normally available prior to start of construction, applicants have initially submitted all the information needed for a full safety evaluation and have accordingly been issued construction permits on the basis of definitive safety findings. These construction permits are accordingly not "provisional" and are subject to none of the safety conditions prescribed for and included in per-

mits issued under Section 50.35 of the Commission's regulations. As the Commission also stated in its opinion, with construction permits of this nature there is "no great formal distinction between the first step construction permit and a second step licensing procedure" (R. 649). Of the 58 such research reactor construction permits listed in Appendix C to respondents' brief (pp. 102-04), 26 were in this category.[4]

While this licensing approach may thus be appropriate for those small research reactors which are now essentially production line models, as well as for large power reactors when they have achieved a degree of standardization sufficient to enable the Commission to make the finding required under Section 102 that they have "practical value" and so are subject to commercial licensing under Section 103, it is wholly impractical for an advanced developmental reactor of the type to which "priority" is to be given by the terms of Section 104. Such a reactor is by its nature and purpose a step beyond previously constructed and operated designs. The Commission has accordingly provided an alternate licensing procedure for reactors in this category which provides a step-by-step series of safety approvals. Contrary to respondents' repeated statements, every one of the nine power reactors listed in Appendix C to their brief—and many of the small research reactors as well—have been licensed by this procedure.

Section 50.35 of the regulations provides the keystone to this step-by-step licensing approach. While not limited in terms to developmental reactors to be licensed under Section 104, it is obviously intended to be utilized primarily for these types, because it is applicable only to those cases "where, because of the nature of a proposed project, an

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[4] CPRR Nos. 9, 10, 12-14, 17, 19, 20, 22-30, 33-36, 39, 41, 46, 50, 54. Copies of these permits are available in the Commission's public document room. Most of the remaining 32 construction permits listed by respondents, as well as those for all of the nine power reactors listed (pp. 17-19, below), were "provisional" and issued on the basis of the less definitive findings called for in Section 50.35 of the regulations.

applicant is not in a position to supply initially all of the technical information otherwise required to complete the application." In such cases, the Commission may issue a construction permit "on a provisional basis without the omitted information", but such permit is subject to the specific condition that there be a later "evaluation by the Commission that the final design provides reasonable assurance that the health and safety of the public will not be endangered." In order to issue such a provisional permit, this regulation requires that the Commission be satisfied that the information available is "sufficient to provide reasonable assurance that a facility of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public and that the omitted information will be supplied."

We shall refer briefly below to respondents' arguments that the findings contemplated by this provision are essentially the same findings that would be required were the construction permit not issued on a "provisional" basis, and also the contention that the findings actually made here did not meet the requirements of this regulation. Before turning to these subsidiary issues, however, it will be worthwhile to explore some important related aspects of the basic regulatory scheme, and the way the Commission has applied it. The purpose of this review is to summarize how not only the construction but also the start-up and operation of a large new reactor must normally proceed on a step-by-step basis, and how the Commission has accordingly geared its regulatory procedure to these practical facts.

Following issuance of the provisional construction permit, and during the necessarily extended period of construction of a large developmental power reactor, there is continuing review of the project by the Commission staff, including review of the progress of the applicant's program of research and developmental work intended to adduce the further technical data required for final evaluation. The nature, extent, and thoroughness of this continuing review of large developmental reactors in general is indicated in

a recent study of licensing procedures prepared by the Commission for the Joint Committee on Atomic Energy, in which the regulatory steps for each licensed power and test reactor thus far proposed are listed and described.[5] In this case this procedure has also included the submission to the Commission and service on all parties on a quarterly basis of detailed technical progress reports, as prescribed by the Commission in its findings (R. 711-12), in its order (R. 713-14) and in the construction permit itself (R. 717-18).

Upon completion of construction of a reactor authorized under Section 50.35 and upon conclusion of the required further proceedings (including a report by the Advisory Committee on Reactor Safeguards and a public hearing[6]), the Commission is not then faced with the black-or-white decision of whether or not, like an ordinary power plant or paper mill, it is to be permitted to be switched on and operated at its designed power. Again, with a standardized production-line type of reactor the Commission may on completion of construction grant a full-power operating

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[5] This study is entitled "The Regulatory Program of the Atomic Energy Commission. A summary of information and materials relating to the AEC's regulatory organization and activities, including chronologies of power and test reactor cases," and is included in Volume II of a recent Joint Committee on Atomic Energy Staff Study on *Improving the AEC Regulatory Process* (March 1961), pp. 87, 151-306.

[6] These are required for all Section 103 and 104 b reactors and for Section 104 c testing reactors by the provisions of Section 182 b and 189 a of the Act, as amended in 1957, and by the provisions of the decision in this case (Finding 37, R. 712; R. 718-19).

Respondents imply that this case should have been referred again to the Advisory Committee on Reactor Safeguards (ACRS) prior to this time. There is no occasion for a further ACRS report, however, until the next stage in the licensing procedure—start-up of the reactor—is reached. In fact the ACRS or one of its subcommittees has met regularly over the last two years with respect to various aspects of this reactor, as part of the continuing safety review during construction discussed above. See *Improving the AEC Regulatory Process, supra* (Joint Committee on Atomic Energy, March 1961, Vol. II, pp. 177-79).

license in a single and rather routine step, and again this procedure has become customary with many of the small research reactors discussed above. With a large power reactor of advanced design, however, the final verification of its safety to operate at its designed power is obtained only by detailed nuclear testing at low and intermediate power levels. As a result largely of experience obtained in the course of licensing the start-up and operation of the first such reactors, the Commission in early 1960 accordingly promulgated Section 50.57 of its regulations to spell out in detail a further series of licensing steps for those cases where such procedure is necessary or appropriate. This regulation is the logical sequel to the provisional construction permit procedure provided by Section 50.35.

Under Section 50.57 of the regulations (Appendix, pp. 36-37, below), an applicant may receive initially one or a series of "provisional" operating licenses, each of which will permit operation of the reactor only for a limited time, at a limited power, and in accordance with such other stated conditions as are appropriate. The safety showing required by this provision of the regulations is not that the reactor can be shown to be safe for operation at its full designed power, but only that those "activities" authorized by the provisional operating license can be conducted without endangering the health and safety of the public." When the results of this limited operation are in hand, they serve to verify whether operation at a somewhat higher power is safe, and it is only when the results of this operation in turn are in hand that operation at a still higher power can be authorized. The number of steps may vary from one or two to as many as four or five. At each step the safety of the proposed operation is reviewed and a definitive determination is made on the basis of all of the available data, including the most recent operating experience. This carefully devised procedure, far from endangering the public health and safety, provides exceptional protection in the form of not one but repeated safety reviews before the final permission to operate the reactor for the full term requested and at its full proposed power is granted.

The uncontroverted expert testimony with respect to the importance of following a step-by-step approach with de-

velopmental reactors and the Commission's findings thereon is summarized in our main brief (pp. 30-32). In 1960, Commissioner Graham reported to the Joint Committee that these views were still held by the "reactor safeguards people", who emphasized that in this area "you are moving on a step-by-step basis", and "you may be designing as you are still building." He added that they did not quarrel with this kind of approach because "you are trying to improve the art, you are trying to make some new steps, and, in the words of the joint committee you are not trying to have just carbon copies." *Hearings Before the Joint Committee on Atomic Energy on Development, Growth and State of the Atomic Industry*, 86 Cong., 2d Sess. (1960), p. 104.

As respondents read the applicable statutory provisions, none of this procedure is valid. The requirement they urge —that in *all* cases a positive safety determination of the proposed operation of the reactor must be made before construction starts—would frustrate the Congressional purpose to foster and expedite developmental reactor projects without contributing to the protection of public safety.

C. THE COMMISSION HAS CORRECTLY AND UNIFORMLY INTERPRETED AND APPLIED ITS REGULATIONS HERE AND IN OTHER POWER REACTOR LICENSING CASES

By a combination of misinterpreting both the Commission's regulations and the particular findings which it made in this case, respondents are able to assert that the Commission's decision here is uniquely erroneous and that in no other case did the Commission exceed its statutory authority (as they and the court below have construed it). In their summary of argument they thus state that (br. p. 24):

> "The applicable regulations of the Commission can be interpreted to fall within the Commission's delegation of authority. As heretofore applied by the Commission in other cases, they are valid. However, as interpreted and applied by the Commission in the case at bar, they are not valid."

In thus differentiating between the Commission's action in other cases and that taken here, respondents are demonstrably wrong.

1. SECTIONS 50.35 AND 50.40 OF THE COMMISSION'S REGULATIONS ARE CONSISTENT WITH EACH OTHER AND WITH THE COMMISSION'S PRACTICE

In support of their interpretation of the regulations, respondents rely primarily on the "common standards" for commercial and developmental licenses and construction permits set out in Section 50.40 (10 C.F.R., Appendix, pp. 35-36, below). They urge that especially subsection (a) of this regulation requires the Commission in terms to find, before it issues *any* license or construction permit, not only that the activities which would be authorized or approved thereby are such as to provide reasonable assurance that the health and safety of the public will not be endangered but also that other activities that would be authorized only by a later operating license (including presumably operation of the reactor at its full designed power) would similarly meet this standard. In other words, they argue that this provision of the Commission's regulations itself imposes at the construction permit stage essentially the same standard of proof of safety of operation which would be required to sustain issuance of the eventual operating license, and that the language of 50.35 of the regulations should similarly be so interpreted.

Apart from the fact that respondents have undertaken a necessarily heavy burden in urging that a regulatory agency has misinterpreted its own regulations (*e.g., Bowles v. Seminole Rock Co.*, 325 U.S. 410, 414), comparison of the language of these two provisions as well as a consideration of the obvious purpose of providing a specific procedure for those construction permits to be issued "on a provisional basis" refutes their argument. If the Commission had intended to require a definitive determination of safety of operation of the particular reactor prior to issuance of a construction permit under all circumstances, it would not have been necessary to include Section 50.35 in its regulations at all, and particularly to articulate therein the specific condition that it was subject to a later determination by the Commission that "the final design" is safe. The obvious purpose of Section 50.35 was to permit construction to begin on a reactor before its "final design" had been definitively

chosen and *a fortiori* before all the information was at hand to provide the requisite degree of proof that such "final design" could be safely operated.

Furthermore, in addition to the controlling necessity for interpreting the general provisions of Section 50.40 in such a way as to be not inconsistent with the more specific terms of other regulations, these provisions on their face do not have the meaning attributed to them by respondents. The concept of a broad category of standards to be commonly applicable to issuance of several classes and types of licenses plainly embodies the application of the stated considerations (to the extent they are in fact applicable) to the activities or other matters with which *the particular license involved* is concerned. As used here, "license" plainly includes "construction permit."[7] Only those activities which would be authorized or approved by the licensing action in question, therefore, are intended to be required by the terms of this particular regulation to be measured by the stated considerations. The Commission has accordingly read all three of the subsections of Section 50.40 as applying only to those things proposed to be approved or authorized by the particular license being considered for issuance—in this case, a provisional construction permit issued under Section 50.35 and which approves and authorizes only construction of the reactor at its proposed location, subject to later determination by the Commission that its "final design" provides reasonable assurance of safe operation there (R. 644).[8] The controlling provisions of Section 50.35, of

[7] Section 185 of the Atomic Energy Act of 1954, providing for construction permits, states that "For all other purposes of this Act, a construction permit is deemed to be a 'license'". Section 50.30 of the regulations (10 CFR), providing for the filing of license applications, adopts this usage by stating that "Each application for a license, *including whenever appropriate a construction permit*, or amendment thereof should be filed with the Atomic Energy Commission . . ." (italics supplied).

[8] This interpretation by the Commission of the specific requirements of Section 50.40, although criticized by respondents as a "patent distortion" and "tongue-in-cheek interpretation" (br.,

course, do require further findings with respect to probable safety of operation, and these were made here (pp. 19-20, below).

2. THE CONSTRUCTION PERMITS ISSUED BY THE COMMISSION FOR OTHER DEVELOPMENTAL POWER REACTORS HAVE BEEN PROVISIONAL AND HAVE BEEN ISSUED FOR REACTORS HAVING SUBSTANTIAL UNRESOLVED TECHNICAL PROBLEMS EXPECTED TO BE SOLVED DURING THE COURSE OF CONSTRUCTION

Analysis of the Commission's construction permit decisions on all of the eight other power reactors authorized prior to the decision of the court below and listed in Appendix C to respondents' brief (p. 102) not only confirms this interpretation of the regulations but utterly refutes respondents' contention that the Commission's practice in these other cases has been in accord with respondents' interpretation of the statute and regulations. Excerpts from the

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pp. 46-47) is plainly correct. The findings required by Section 50.40(b) with respect to technical qualification to engage in the "proposed activities," and by Section 50.40(c) that "issuance of a license" will not be "inimical to the common defense and security or to the health and safety of the public" have usually been made in construction permit decisions in terms only of design and construction of the reactor and of issuance of the construction permit, respectively, without reference to operation or issuance of an operating license. See, *e.g.*, Saxton Nuclear Experimental Corp. and Carolinas Virginia Nuclear Power Associates, Inc., Govt. Reply Brief Appendix B, pp. 63-64, and most of the research reactor construction permits listed in Appendix C to respondents' brief beginning with CPRR-6 of August 29, 1956, available in the Commission's public document room. See also Findings 29-35, R. 710-11. Since in most cases the applicant has also requested an allocation of special nuclear material to be included in his construction permit in accordance with Section 50.60(c) of the regulations, there has usually been a finding of financial qualification both to construct the reactor as required by Section 50.40(b) and to operate it for a reasonable period of time in accordance with Section 50.60(c). See, e.g., Consolidated Edison Co., CPPR-1, Govt. Reply Brief Appendix B, p. 62, and Finding 34, R. 711. See also AEC Opinion, R. 680-81, 685.

construction permits and supporting findings for each of these reactors are contained in Appendices A and B to the Solicitor General's Reply Brief in No. 454. Inspection of this material will show that in each case the construction permits were issued on a provisional basis under Section 50.35 of the regulations, prior to the availability of all the required technical information, and on the basis of findings of reasonable assurance of safety of operation only of "the general type proposed", in the words of that regulation. Each of them also contains the specific condition required by Section 50.35, that the permit is "provisional" and subject to the production of the omitted data and to a later finding by the Commission that the final design provides adequate protection to the public health and safety.

That the findings made in these cases of reasonable assurance of safety of the general type or design concept proposed were not intended to be of the definitive nature which respondents claim to be required by the statute is further confirmed by the fact that in many instances the unresolved technical problems presented by the particular reactor were specifically spelled out in the construction permit or decision. See material quoted in Govt. Reply Brief Appendix A, pp. 51-61, with respect to CPPR Nos. 5, 6, 7, 8, 9. Thus in the first construction permit order entered by the Commission after enactment of the 1957 amendments to the Act requiring publication of the report of the Advisory Committee on Reactor Safeguards and a public hearing, the full Commission issued an accompanying opinion which made the nature of its construction permit findings perfectly clear. *In Matter of Yankee Atomic Electric Co.*, Docket No. 50-29 October 31, 1957 (Govt. Reply Brief Appendix A, pp. 52-53), the Commission stated:

> "The construction permit must be provisional at this stage of the proceeding principally because Yankee has not completed the design of the reactor and certain features of the proposed facility present unresolved questions which might affect its safe operation. These features have been identified and discussed in the testi-

mony furnished at the hearing by Dr. Clifford K. Beck, Chief of the Hazards Evaluation Branch, and in the report of the Advisory Committee on Reactor Safeguards. We agree with Dr. Beck and the Advisory Committee that the experimental program outlined in the application will probably produce the information needed to resolve these questions prior to consideration of final design and operating procedures and conversion of the construction permit to a license."

There is no validity to respondents' repeated statement that the Commission's interpretation of the statute and regulations and its application thereof in other cases have been in accord with their contentions here.

3. THE FINDINGS HERE ARE EQUIVALENT TO THOSE MADE IN OTHER CASES —

Respondents further seek to distinguish the findings made here in accordance with Section 50.35 of the regulations from those made in all other cases on the ground that when the Commission included in certain of the findings here the words "for purposes of a provisional construction permit", it intended a major change in the purport of the finding. In numerous places in their brief, respondents urge that the use of this phrase means that the Commission intended to find no more than that the construction work itself could be carried on safely. See pp. 26, 57, 61, 72, 78.[9] Even a cursory examination of the findings as a whole and of the Commission's opinion makes it clear that this is not so. The Commission here, as in its other developmental power reactor cases, found a reasonable assurance that a reactor "of the general type proposed" could be operated at the proposed location without undue risk to the health and safety of the public, and that the omitted technical data

[9] Respondents apparently base this argument with respect to what the Commission's findings under Section 50.35 of the regulations mean by reference to the Commission's explanation (R. 643-44) of what the very different language in its "common standards" regulation, Section 50.40, means. See respondents' brief pp. 46-47 and discussion of Section 50.40, pp. 16-17, above.

would be supplied. See Findings 18c, 21, 22, 30, 31, 32, 33, R. 706, 707-08, 710-11. As its opinion made clear, these findings here (and in the other provisional construction permit cases) were made on the basis of a lesser degree of "reasonable assurance" than would be required for approval of actual operation, and because of the nature of the issue, were necessarily made in terms of an informed probability that the necessary definitive safety verification could be made. It is plain, however, that the whole regulatory concept of provisional construction permits for developmental reactors is and must be based on this approach.[10]

The use of the phrase "for purposes of the provisional construction permit" in some but not all of the Commission's safety findings here has no more significance than to emphasize, in this first contested licensing case, that the Commission was *not* making the definitive safety determination which would be required later and which respondents had urged should be required to be made then.

D. DEVELOPMENTS FOLLOWING ENACTMENT OF THE 1954 ACT RELIED UPON BY RESPONDENTS PROVIDE FURTHER INDICATION OF ACQUIESCENCE BY CONGRESS IN THE COMMISSION'S PROVISIONAL CONSTRUCTION PERMIT PROCEDURES

Respondents urge that the Commission "did not keep the Joint Committee fully informed about the application of the construction permit procedure" and that there was no acquiescence in this procedure by Congress (br. p. 60). The very quotation there given from a Commission letter to the Joint Committee of October 9, 1956, published in that Committee's 1957 Staff Report on "A Study of AEC Procedures and Organization in the Licensing of Reactor

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[10] See Commission's 1956 explanation to the Joint Committee of its provisional construction permit procedure, quoted below, p. 21; see also Finding 31 (R. 710) that "There is reasonable assurance that theoretical and experimental programs under way will develop sufficient data to justify the issuance of an operating license, and that the results of these programs will be available prior to the time it is necessary for the Commission to rule on the operating aspect of the PRDC license Application."

Facilities" (p. 197) proves the contrary. In this letter the Commission explains that its finding in "conditional construction permit" cases is not the positive one urged by respondents that the proposed reactor can be safely operated, but rather a finding of "reasonable assurance that the unresolved safety problems can be resolved" so as to make such operation safe. This is a fair summary of the approach taken in Section 50.35 of the regulations and consistently applied by the Commission here and in other provisional construction permit cases.

Any doubt that this is what was meant is eliminated by the next paragraph of the same 1956 Commission letter to the Joint Committee, which respondents did *not* quote. This includes the further explanation that

> "the issuance of a conditional construction permit merely means that, based on existing information, it is the opinion of the Commission that it will be possible for the designers of the reactor to resolve any existing design and operational uncertainties in such a way that when the final design and operating procedures of the reactor, including its containment, are evaluated, they will be found to offer no unacceptable hazards" (*Study of AEC Procedures*, *supra*, p. 308).

That the Joint Committee so understood and accepted the Commission's regulatory scheme is further indicated by the reasons expressed for not approving what respondents call "the only aspect of the PRDC proceeding that came before it for consideration" (br. p. 62). On June 27, 1957, while the construction permit hearings in this case were still being held before a Commission hearing examiner, representatives of respondents testified at hearings held before a subcommittee of the Joint Committee with respect to appropriation authorization legislation, and strenuously opposed the authorization of appropriations to the Commission for research and development work in support of the PRDC project. This work was to be done under a contract between the Commission and PRDC which called for such assistance and which had been exe-

cuted under the Commission's Power Demonstration Reactor Program. See *Hearings Before the Subcommittee on Legislation of the Joint Committee on Atomic Energy on Authorizing Legislation for AEC's Fiscal Year 1958 Construction Budget*, 85th Cong., 1st Sess. (1957), pp. 597-633. PRDC's statement submitted to the Joint Committee in reply to this testimony contained among other things an explanation of the factual issues in the then pending proceeding and an analysis of the Commission's provisional construction permit practice (*id.* at pp. 633-39).

In its report on authorizing legislation, the Joint Committee recommended denial of funds for the PRDC contract on the ground that the project was the subject of pending litigation:

> "The committee does not approve the requested authorization for preconstruction research and development work and waiver of fuel-use charges in connection with the reactor project of the Power Reactor Development Co., since legal proceedings before the AEC *to determine the probable safety of the proposed reactor* are still pending" (italics supplied).[11]

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[11] (Sen. Rep. No. 791, H. R. Rep. No. 978, 85th Cong., 1st Sess. (1957), p. 19. In the legislation as enacted, no funds were authorized in terms for the PRDC contract, but the very amount which had been requested for this purpose was in fact authorized "for research and development in Commission laboratories to advance the technology of the fast breeder concept" (P.L. 85-162, Section 111(a)(2), 71 Stat. 409). The further legislative history of this provision made it clear that Congress intended to authorize the Commission in its discretion to use these funds for the specific research and development work contemplated by the contract with PRDC. See summary in *Hearings Before the Subcommittee on Legislation of the Joint Committee on Atomic Energy on AEC Authorizing Legislation*, 85th Cong., 2d Sess. (1958), pp. 374-84. As Chairman Durham of the Joint Committee stated on the floor, "It is understood by most of the members that the $1,500,000 can be expended for research and development of benefit to that [PRDC] project, and it should be expended." 103 Cong. Rec. 14116 (1957). This approach was followed in the subsequent appropriation action

The Joint Committee thus recognized that the issue then pending before the Commission in this case was not whether the Commission could make a positive finding at that time that the reactor could be safely operated as proposed, as respondents contend, but rather whether it could determine "the probable safety of the proposed reactor." It thus understood that the finding called for by Section 50.35 of the Commission's regulations was one of reasonable assurance in terms of informed probability that the requisite positive safety showing could later be made. As pointed out in our main brief (pp. 49-51), at that time Congress had under consideration certain proposed amendments to the licensing provisions of the Act which it later adopted without including therein any amendment to alter the Commission's provisional construction permit practice.

That practice was again described to the Joint Committee in the following year (1958), and subsequently. See AEC Opinion, R. 655-58 and citations in footnote 31, p. 50 of our main brief. Respondent's statement (br. pp. 53-54) that in connection with a proposed revision, later withdrawn, to Section 50.35 of the regulations the Commission advised the Joint Committee that the regulation requires a finding of definite assurance of safe operation at the time the construction permit is issued is refuted by respondents' own quotations from the relevant hearings, in which the Commission once again took the position that the existing provisional construction permit regulation required not a definitive safety finding with respect to the particular reactor but "reasonable assurance, in effect, that this

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taken. See Conference Report on H. R. 9379, H. R. Rep. No. 1242, 85th Cong., 1st Sess. (1957), p. 2, cited by respondents at p. 62 of their brief.

It was in connection with this controversy that the Chairman of the Commission wrote the Chairman of the Joint Committee urging approval of appropriations to enable the Commission to carry out its contractual obligations and pointing out that, in reliance on such obligations, PRDC had expended substantial sums. Daily Cong. Rec., Aug. 5, 1957, pp. A6320-21; respondents' brief, p. 67.

research program will be successful."[12] Such findings, not challenged in these judicial review proceedings as unsupported by the evidence, were made here. See Findings 18c, 21, 22, 30, 31, 32, 33; R. 706, 707-08, 710-11. See also Opinion, R. 665, 676-77.

It is quite true that various aspects of the Commission's handling of the early phases of the PRDC case evoked criticism from some members of the Joint Committee. A particular target for this criticism was the Commission's then practice of not releasing letters received from its Advisory Committee on Reactor Safeguards, and of issuing licenses without prior notice but subject to later hearings if requested. In these respects, the 1957 amendments to the Act effected changes in the licensing procedures thereafter followed. Since in fact the Commission's order now under review was issued on the basis of findings of fact made after extensive hearings, prior to which the Advisory Committee's earlier letter had been made public, the validity of the criticism which was made of the Commission's earlier procedures is not here in issue.

In this connection, it should be noted that the original report of the Advisory Committee on Reactor Safeguards on the PRDC project did not, as respondents infer, recommend against the issuance of a provisional construction permit. On the contrary it expressed the Committee's opinion as of June 1956 that there was not then sufficient information to provide the kind of assurance that "the proposed reactor" could be safely operated to permit approval of such operation and it recommended an expanded re-

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[12] See respondents' brief, p. 55; *Hearings Before the Joint Committee on Atomic Energy on Development, Growth, and State of Atomic Energy Industry*, 87th Cong., 1st Sess., p. 73, Official Transcript, February 21, 1961. As recently as March 1961, the provisional construction permit procedure was again described in a report by the Commission to the Joint Committee in terms of findings of reasonable assurance of safety of "the general type proposed", with "further and more definitive evaluations of safety" being made prior to issuance of an operating license. See *Improving the AEC Regulatory Process*, Joint Committee on Atomic Energy, March, 1961, Vol. II, p. 154.

search and development program (R. 587-93), which has since been carried out, to obtain the requisite safety verification. Six of the members of this Committee testified in the hearings in this case; some of their testimony was summarized in the Commission's opinion as so interpreting the Advisory Committee's original letter, and as concluding that the requisite data to prove that the reactor could be safely operated would probably be obtained (R. 672-76). This testimony formed an important basis for the Commission's findings of fact. As noted above, these findings have not been attacked in these judicial review proceedings as unsupported by the evidence.[13]

II

The site findings made met the requirements of the statute and the regulations

Since respondents do not now urge that the statute requires the Commission to find "compelling reasons" to justify the location of any large power reactor at a site located in an area having a population distribution comparable to that found here, we need not elaborate on the discussion of this question contained in our main brief. Respondents do urge, nevertheless, that the Commission's findings with respect to site were deficient, and they lift out of context a single statement in the Commission's opinion to support a contention that the Commission failed to give any consideration whatever to the question of the surrounding population. We think that this contention is groundless and that the Commission's findings here with respect to site plainly met the requirements of both the statute and the regulations.

Before the Commission can make the positive safety determination required to authorize operation of this or any

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[13] In accordance with amended Section 182 b of the Act, a further public report by the Advisory Committee on Reactor Safeguards will be made prior to the holding of hearings on a license to start up the reactor. There has been no occasion to request such a further report prior to this time. See p. 12, n. 6, above.

other reactor, it must take into consideration not only all of those features of the "final design" of such reactor that have a bearing on safety, including the effectiveness of the containment and other protective devices provided, but also the environmental characteristics of the site. The Commission plainly recognized this when it stated in its opinion that "the question of safety obviously cannot be considered without regard to proposed location" (R. 677).

When a provisional construction permit is under consideration, however, a more limited aspect of the problem is presented. By hypothesis, the final design of the reactor and of all its safety and protective features has not yet been positively settled. Yet the site is definitely chosen at the time the construction permit is issued. The Commission's consistent practice under Section 50.35 of its regulations, accordingly, has been to determine at that time the suitability of the site for a reactor of the general size and type proposed, coupled with a determination in terms of "reasonable assurance" that the precise design features and protective devices needed to make such reactor adequately safe for this location can be developed and verified during construction.

The extent of the theoretical hazard from any reactor is determined by the quantity of the toxic fission products which are built up in its fuel elements during the course of its operation; this amount is in turn a function of reactor size or power and of the length of time for which it has operated without reloading of nuclear fuel (R. 739-44, 874-78, 901). For this reason, it is both sensible and practicable in evaluating the suitability of a site to do so in terms of the size (power) and general type of the proposed reactor to be placed thereon.[14]

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[14] The importance of the power level of a proposed reactor in evaluating the suitability of its site from a population distribution standpoint has been recognized in criteria for site evaluation recently tentatively proposed by the Commission (26 Fed. Reg. 1224). See p. 29, below.

This is just what the Commission did here. Its site findings are, contrary to their characterization by the court below and by respondents, both plain and definite. Furthermore, while respondents object to our reference to all of these findings as "uncontested" (br. p. 83), it is certainly undisputed that no contention was advanced in the court below or is made here that they or other related findings were not adequately supported by the evidence.

First, the Commission found for purposes of the provisional construction permit that a reactor "of the general type proposed in the PRDC Application and amendments thereto can be constructed and operated at the location without undue risk to the health and safety of the public" (Finding 22, R. 708), and that a reactor of such type "can be so designed that no credible accident in the course of its operation is likely to result in the release of significant quantities of fission products into the atmosphere" (Finding 30, R. 710).

Even more specifically, and without reference to the provisional construction permit, the Commission made the definite finding of "reasonable assurance that the proposed site is generally suitable for a reactor of the type and size described in the Application, if the reactor is otherwise shown to be capable of operation without undue risk to the public health and safety, including demonstrations of stability and adequate containment" (Finding 32, R. 710). It coupled this with the further unqualified finding that there was "reasonable assurance that theoretical and experimental programs under way will develop sufficient data to justify the issuance of an operating license, and that the results of these programs will be available prior to the time it is necessary for the Commission to rule on the operating aspect of the PRDC license Application" (Finding 31, R. 710).

Finally, the Commission found that "the site will prove suitable for the proposed reactor" if it is demonstrated that it is inherently safe and that "no credible accident can release significant quantities of fission products into the atmosphere," and it added that "there is reasonable as-

surance" that these can be established (Finding 21, R. 707-08). In support of the foregoing the Commission included in its findings a description of the site which recited in detail the population distribution around it (Finding 19, R. 706-07; see also R. 677, n. 62).

Respondents attempt to dismiss these findings by drawing comparisons with the language used by the Commission in its Initial Decision (to the form of which they also objected), and by urging that a clause in the Commission's opinion to the effect that "safe operation of the reactor will be as likely in that location as in any other location" (R. 678) indicates that the Commission totally disregarded population in its evaluation of the site.

The statement referred to followed a determination that the information then available was sufficient to give reasonable assurance that the site was satisfactory from structural and underground water flow standpoints. It noted that studies of certain other categories of environmental data including weather, hydrology and geology were still in progress, and it then added the statement so heavily relied on by respondents that

> "Although the data of these types are not yet complete or conclusive, the record gives reasonable assurance that safe operation of the reactor will be as likely in that location as in any other location. We anticipate that knowledge to be acquired will fortify that assurance" (R. 678).

What the Commission was primarily talking about here was the meteorological, hydrological and similar data which at that time had not been completely compiled. These data, as the Commission indicated, were not of a nature to be "disqualifying" (R. 678), but were of a type which, if they turned out to be particularly unfavorable, could be engineered against. The undisputed testimony is that any problems presented by further data to be obtained in these categories could be solved by careful engineering and the

adoption of properly developed operating procedures,[15] and the Commission in its Finding 20 recognized this by noting that any "design modifications required by the results of those studies" would be considered at the time the question of an operating license is considered (R. 707).

Finally, respondents refer to certain population distribution criteria for reactor sites, recently proposed by the Commission, as somehow reflecting adversely on the Commission's findings here. In fact, as respondents have to admit (br. p. 89), the PRDC site satisfies the proposed criteria in all particulars by a wide margin; the exclusion distance of some 2900 feet for the proposed reactor, for example (R. 706-07), is more than double the minimum of 0.24 miles (1277 ft.) suggested for a reactor of the proposed power (300 megawatts). See 26 Fed. Reg. 1226, Feb. 11, 1961. Whether the final design, including proven protective mechanisms for the particular reactor as completed and tested, provides sufficient protection to public health and safety for operation at the power to be initially authorized under Section 50.57 of the regulations is the issue to be determined in the forthcoming operating license proceedings. As stated above, we believe the Commission's findings in this area (summarized above, pp. 27-28) clearly satisfy the requirements imposed for issuance of a provisional construction permit. This is the only issue presented at this stage of the proceedings.

[15] Arthur E. Gorman, PRDC consultant and sanitary engineer with reactor environmental experience as a former member of the Commission staff, stated: "Any difficulties which I can foresee from possibly unfavorable environmental information yet to be obtained —such as that on meteorology and water currents—are difficulties which I believe can be solved by careful engineering and the adoption of properly developed procedures of operation" (Tr. 4259; not printed). See also Tr. 3754 and testimony of Dr. Abel Wolman, R. 109-10. Mr. Gorman also testified that much of this type of environmental data is information which by its nature takes a long time to compile (Tr. 4258-59), and that he did not know of any site at which it was not necessary to collect much of it during the construction period (Tr. 3804-05, not printed).

III

Respondents have no basis for asserting that reactor safety experience has been alarming or that this reactor now presents major unresolved safety questions

In spite of respondents' efforts to give a contrary impression, the reactor safety record in this country and abroad has been remarkably good and compares favorably with that in any conventional heavy industry. In an appendix to their brief, pp. 105-08, they list some 22 "reported atomic reactor accidents" in the United States and an additional 19 in foreign countries, an unstated number of which they describe as "causing serious injuries to reactor personnel and undetermined injuries to the surrounding population" (p. 15). This is grossly misleading. The fact is that, as reference to a more complete and accurate summary of these occurrences contained in Appendix C to the Solicitor General's Reply Brief in No. 454 shows (pp. 66-91), the great majority of these "accidents" cannot properly be so classified at all, but were merely operating difficulties of varying magnitude, resulting in no injury or danger to operating personnel or the public, or even significant damage to the reactor itself. Moreover, several of them occurred in experimental reactors during experiments in which standard safety precautions were dispensed with in order to achieve the experimental conditions desired.[16]

Not a single one of the so-called "accidents" is known to have caused death or any injury whatever to a member of the public or to anyone outside of the reactor structure. Nothing in reactor experience to date is inconsistent with

[16] An example is the excursion experienced by the Commission's Experimental Breeder Reactor No. 1 (EBR-1) in 1955, which occurred when the reactor was purposely put on a fast rising power curve after intentionally disconnecting certain safety mechanisms and stopping the flow of coolant. Contrary to the implication in respondents' brief (p. 89, n. 45), no significant amount of radioactivity was released. No one was injured in any way. See testimony of Dr. Norman Hilberry, Director of the Argonne National Laboratory, R. 791-92.

the expert opinion mentioned in the Commission's Brookhaven Report and referred to in the report of the Joint Committee on Atomic Energy on the 1957 amendments to the Act, that the chance of a member of the public being killed by a reactor accident in any of an assumed 100 reactors operating in populated areas in the United States is of the order of one in 50 million. See R. 884-85, and Sen. Rep. No. 296, H.R. Rep. No. 435, 85th Cong., 1st Sess. (1957), pp. 2, 3.

The further implication in respondents' brief that the PRDC reactor is particularly dangerous and that even today serious safety problems remain unsolved is also without foundation in fact. Admittedly, this reactor represents a substantial step forward in reactor design, and the over-all project is one calculated in the words of Section 104 of the Act to "lead to major advances in the application of atomic energy for industrial or commercial purposes." As the Commission has summarized in its opinion and findings, however, the reactor is by no means the first of its kind; a great deal of successful operating experience has been obtained from a small sodium-cooled fast breeder reactor (EBR-I) first operated by the Commission in August 1951 (Finding 4, R. 701-02). In fact, this was the world's first nuclear reactor to generate electricity (R. 828-30). There is also very considerable experience in the use of liquid sodium and related materials as coolants, so that this important phase of the PRDC project is based on well established technology (Finding 9, R. 703). In addition, two other large fast breeder reactors referred to in the Commission's findings (R. 702) have been built; one of these, a reactor constructed by the United Kingdom Atomic Energy Authority at Dounreay, Scotland, has been undergoing low power operational testing since December, 1959, and the second, the Commission's own Experimental Breeder Reactor No. 2, is now expected to be loaded with fuel and to undergo nuclear testing during the late spring and early summer.[17]

[17] Respondent's statement that the Dounreay reactor has en-

With every reactor type there are certain events which must particularly be guarded against. As the Commission pointed out in its opinion, with a fast reactor of this type the fuel elements must be so designed that they cannot when heated "bow" or bend inward to produce a reactor instability; this and other precautions are needed to prevent the possibility that the fuel will so overheat as to melt down (R. 669-72). On the other hand, a reactor of this general design has inherent safety features not available to other types, such as very small excess reactivity in the control system and complete absence of any high pressures around the reactor itself. See AEC Opinion, R. 672; testimony of Dr. Hans Bethe, R. 742-43, 748-49. As one of the Commission's uncontested findings concludes, "There is no inherent hazard or danger to the health and safety of the public in the construction or operation of fast breeder reactors" (Finding 5, R. 703).

The statement by respondents that PRDC has not yet solved the problem of possible inward bowing of fuel elements (br. p. 9) is simply untrue. After tests in hot liquid sodium conducted over a considerable period of time had indicated that certain metallurgical characteristics of the uranium fuel pins required a different support structure than provided by the original design, the mechanical method of supporting the fuel pins was redesigned to provide a honeycomb grid support made of stainless steel approximately every three inches. This redesign was adopted in

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countered "unique fast reactor problems" (br. p. 74) is not true. Because of certain features of its particular design and start-up method, which features are incorporated in neither the PRDC reactor nor the Commission's EBR-II, certain mechanical and operational difficulties have been encountered which have limited the power at which the British reactor has thus far been able to operate. There has been no indication, however, of any inherent problem which can be expected to be encountered in the PRDC design. See description in *Symposium on the Dounreay Fast Reactor*, British Nuclear Energy Conference, London, December 7, 1960, pp. 74-85.

the summer of 1960 and extensive testing has recently been satisfactorily completed.[18]

Far from showing any inherent dangers in this reactor, the history of the design, initial testing, redesign and final testing of the fuel support structure in fact serves as an illustration of the practical wisdom of the Commission's approval of what the late Dr. Mark Mills called the "combined construction and research and development and necessary dovetailing of these things" (R. 676, 73-74). Not unexpectedly, some delay beyond the original estimate has been encountered in completion of this and other developmental reactors which have gone forward on this basis, but it is clear that, as the Commission here found (Finding 27, R. 709):

> "By proceeding with construction and further research and development simultaneously, rather than awaiting complete research and development results, Applicant will save several years in the time required to place in operation its demonstration power reactor."

CONCLUSION

In providing for a step-by-step licensing procedure in its regulations the Commission properly exercised the authority delegated to it by Congress. Its findings in this

[18] Respondents' quotation out of context of a statement contained in a request to the Commission of October 28, 1960 for delay in the proposed completion date of the reactor (a copy of which has been lodged with the clerk) is quite misleading (br. p. 9). The sentence in this request which immediately follows the statement quoted shows the redesign of the fuel support structure to have been then completed, and PRDC's Eighth Quarterly Technical Report, dated September 10, 1960 and served on respondents pursuant to the terms of the Commission's order and the modified construction permit (R. 713-14, 717), had spelled this out in detail. Further tests of the redesigned structure for some 2500 hours in flowing sodium at a temperature of 1000° F. (substantially above the reactor operating temperature) and at 150% of normal flow rate have very recently been concluded with satisfactory results.

case satisfy these regulations and are comparable to those made in other developmental power reactor proceedings. The judgment below should be reversed.

Respectfully submitted,

JOHN LORD O'BRIAN,
W. GRAHAM CLAYTOR, JR.,
DAVID E. McGIFFERT,
701 Union Trust Building,
Washington 5, D.C.

EDWARD S. REID, JR.,
RICHARD B. GUSHEE,
3456 Penobscot Building,
Detroit 26, Michigan.

Attorneys for Petitioner
Power Reactor Development Company

COVINGTON & BURLING,
Washington, D.C.

MILLER, CANFIELD, PADDOCK AND STONE,
Detroit, Michigan.

Of Counsel.

APRIL 24, 1961.

APPENDIX

Atomic Energy Commission Regulations

(10 C.F.R., Chapter 1)

Section 50.10. *License required.*

* * * * *

(b) No person shall begin the construction of a production or utilization facility on a site on which the facility is to be operated until a construction permit has been issued. As used in this paragraph, the term "construction" shall be deemed to include pouring the foundation for, or the installation of, any portion of the permanent facility on the site; but does not include:

(1) Site exploration, site excavation, preparation of the site for construction of the facility and construction of roadways, railroad spurs and transmission lines;

(2) Procurement or manufacture of components of the facility;

(3) Construction of non-nuclear facilities (such as turbo-generators and turbine buildings) and temporary buildings (such as construction equipment storage sheds) for use in connection with the construction of the facility; and

(4) With respect to production or utilization facilities, other than testing facilities, required to be licensed pursuant to section 104 a. or section 104 c. of the Act, the construction of buildings which will be used for activities other than operation of a facility and which may also be used to house a facility. (For example, the construction of a college laboratory building with space for installation of a training reactor is not affected by this paragraph.)

* * * *

Section 50.40. *Common standards.* In determining that a license will be issued to an applicant, the Commission will be guided by the following considerations:

(a) The processes to be performed, the operating procedures, the facility and equipment, the use of the facility, and other technical specifications, or the proposals in regard to any of the foregoing collectively provide reasonable assurance that the applicant will comply with the

regulations in this chapter, including the regulations in Part 20, and that the health and safety of the public will not be endangered.

(b) The applicant is technically and financially qualified to engage in the proposed activities in accordance with the regulations in this chapter.

(c) The issuance of a license to the applicant will not, in the opinion of the Commission, be inimical to the common defense and security or to the health and safety of the public.

* * * *

SECTION 50.57. *Provisional operating license.*

(a) As an intermediate procedure prior to issuance of an operating license pursuant to § 50.56, the Commission may issue a provisional operating license in a proceeding where findings required for the issuance of a final operating license cannot be made because (1) construction of the facility has not been completed, or (2) there are involved features, characteristics, or components of the proposed facility as to which it appears desirable to obtain actual or further operating experience before issuance of an operating license for the full term, up to forty (40) years, requested in the application.

(b) In any case subject to paragraph (a) of this section, a provisional operating license will be issued by the Commission upon finding that:

(1) Construction of the facility has proceeded, and there is reasonable assurance that the facility will be completed, in conformity with the construction permit and the application as amended, the provisions of the Act, and the rules and regulations of the Commission; and

(2) There is reasonable assurance (i) that the activities authorized by the provisional operating license can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the regulations in this chapter; and

(3) The applicant is technically and financially qualified to engage in the activities authorized by the provisional operating license in accordance with the regulations in this chapter; and

(4) The applicable provisions of Part 140 of this chapter have been satisfied; and

(5) There is reasonable assurance that the facility will be ready for initial loading with nuclear fuel within ninety (90) days from the date of issuance of such provisional license.

(c) Each provisional operating license will include appropriate provisions with respect to any uncompleted items of construction and such limitations or conditions as are required to assure that operations during the period of the provisional operating license will not endanger public health and safety.

(d) The duration of each provisional operating license will be specified therein, not to exceed eighteen (18) months from the date of issuance; provided, however, that upon good cause shown, the expiration date of the provisional operating license may be extended.

(e) In cases where hearings have been held in connection with proceedings under this section, the presiding officer may, upon good cause being shown, provide that any intermediate decision and order issued pursuant to this section shall become effective immediately upon issuance subject to (1) the review thereof and further decision by the Commission upon exceptions thereto filed by any party within twenty (20) days after issuance of such intermediate decision, pursuant to the Commission's rules of practice, and (2) such further order as the Commission may enter upon such exceptions or upon its own motion within forty-five (45) days after the issuance of such intermediate decision; provided, however, that in the absence of any further Commission order pursuant to the foregoing and exceptions to the intermediate decision, the intermediate decision of the presiding officer shall become the final decision of the Commission at the end of such forty-five (45) day period. In the event of objection by any party to immediate effectiveness of such intermediate decision and order, the presiding officer may in his discretion stay such effectiveness pending filing by such party within five (5) days of exceptions to the provision for immediate effectiveness and thereafter until decision on such exceptions by the Commission.

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No. 454

In the Supreme Court of the United States

OCTOBER TERM, 1960

UNITED STATES OF AMERICA AND ATOMIC ENERGY COMMISSION, PETITIONERS

v.

INTERNATIONAL UNION OF ELECTRICAL, RADIO AND MACHINE WORKERS, AFL–CIO, ET AL.

ON WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

REPLY BRIEF FOR PETITIONERS

ARCHIBALD COX,
Solicitor General,
WILLIAM H. ORRICK, Jr.,
Assistant Attorney General,
DANIEL M. FRIEDMAN,
Assistant to the Solicitor General,
MORTON HOLLANDER,
Attorney,
Department of Justice, Washington 25, D.C.

NEIL D. NAIDEN,
General Counsel,
COURTS OULAHAN,
Deputy General Counsel,
LIONEL KESTENBAUM,
Attorney,
Atomic Energy Commission, Washington 25, D.C.

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REPLY BRIEF FOR PETITIONERS

The central issue in this case is whether the procedure followed by the Atomic Energy Commission to protect the public health and safety in connection with the PRDC Reactor accords with the Atomic Energy Act of 1954. The Commission held a hearing on the PRDC application for a license to construct and operate the Fermi reactor and found (R. 708):

> reasonable assurance in the record, for the purposes of this provisional construction permit, that a utilization facility of the general type proposed in the PRDC Application and amendments thereto can be constructed and

operated at the location without undue risk to the health and safety of the public.

The Commission thereupon issued a provisional construction permit. It also announced that it would not issue a license to operate unless it was demonstrated at a further hearing that the reactor as finally designed would be operated without danger to the health and safety of the public (R. 712, 718–719).

In our opinion this procedure conforms exactly to the Commission's regulations and its consistent practice in other cases involving large developmental reactors. Consequently, our main brief is chiefly concerned with the interpretation of the Atomic Energy Act.

Respondents have introduced a diffuse variety of additional questions. Although the only order under review is the order dated May 26, 1959, continuing the construction permit, as amended, they attack the original provisional construction permit issued August 4, 1956. It is now necessary, therefore, to give the Court a brief account of that aspect of the proceeding. See pp. 3–7, *infra*.

Respondents also argue that the Commission's findings in this case do not conform to its own regulations. The argument is based partly upon contentions concerning the meaning of the regulations and partly upon respondents' interpretation of the Commission's findings, which varies from time to time throughout its brief. Since the meaning of the findings must be established before one can determine whether the findings conform to the regulations and

the statute, we shall also discuss this issue before turning back to the central question in the case. See pp. 7–19, *infra*.

Finally, since respondents appended to their brief a list of so-called "accidents" at atomic reactors, we shall discuss the extraordinarily high safety record of this field of activity. See pp. 41–45, *infra*.

I

THE PROPRIETY OF THE ISSUANCE OF THE ORIGINAL CONSTRUCTION PERMIT IN 1956 IS IRRELEVANT TO THE ONLY ISSUE BEFORE THE COURT, NAMELY, THE VALIDITY OF THE 1959 AMENDED CONSTRUCTION PERMIT

The PRDC application was filed on January 6, 1956. Under the Act and regulations at that time, the Commission was authorized to issue provisional construction permits without a hearing provided that it gave any protestants an opportunity to be heard upon request filed within 30 days after issuance. The Commission referred the application to the Advisory Committee on Reactor Safeguards. The Committee reported (R. 587–593) that there was insufficient information available at that time to give assurance that the PRDC reactor could be operated at the site without public hazard and that it was doubtful whether even an accelerated program of research and development would give the assurance before the scheduled completion of the reactor in the summer of 1959. The Commission conducted further investigations and on August 4, 1956, granted a provisional construction permit (R. 516–523). Commissioner Murray dissented.

There was sharp criticism of this procedure from the Joint Congressional Committee on Atomic Energy and in Congress, both because the Commission had issued a construction permit without a hearing and also because it had acted in the face of a discouraging ACRS report.[1] The Atomic Energy Act of 1954 was subsequently amended to require a hearing before the issuance of construction permits, to provide a statutory basis for the Advisory Committee's activities, and to require that its report be made public. The handling of the PRDC Application at this stage and especially the alleged suppression of the ACRS report[2] became an item in the political contest over the

[1] A full explanation of the considerations that led the Commission to issue the original permit, including its analysis of the ACRS report, is contained in a 1956 letter from the Commission to the Joint Committee on Atomic Energy, set forth at pages 136–155 of *A Study of AEC Procedures and Organization in the Licensing of Reactor Facilities*, 85th Cong., 1st Sess. (Joint Committee Print 1957).

Respondents state (Br. 17, n. 15) that the PRDC project has not, since the 1957 legislation, been referred to the Advisory Committee. While no formal reference is required until application is made for an operating license (Section 182(b)), the Advisory Committee has been regularly reviewing the PRDC project to date, and its subcommittee has had periodic meetings with the AEC staff and PRDC personnel. *Improving the AEC Regulatory Process*, 87th Cong., 1st Sess. (Joint Committee Print 1961), Vol. 2, pp. 177–179. A formal report will be rendered by the Advisory Committee prior to the hearing upon an application for an operating license.

[2] The Commission's uniform policy, until the 1957 legislation, was to consider such communications from the ACRS as internal documents protected by executive privilege. See *Improving the AEC Regulatory Process*, *supra*, Vol. 1, pp. 447–448.

nomination of Commissioner Strauss to be Secretary of Commerce.

Three points concerning this initial phase of the PRDC proceeding should be clearly understood.

1. The original provisional construction permit is not before this Court. After the original phase was completed, the ACRS report was released, and a full hearing was held. The Commission made specific findings concerning the safety of the Fermi reactor upon new and more complete evidence. Not even Respondents argue that any mistakes in the original issuance of the provisional construction permit invalidated the order under review. And whatever may be the merits of that earlier controversy, it involved no violation of the statute.

2. The report of the Advisory Committee on Reactor Safeguards casts no doubt upon the Commission's finding that there is reasonable assurance that a reactor of the general type proposed in the PRDC application can be constructed and operated safely at Lagoona Beach. More than two years had intervened between the ACRS report and the Commission's findings after the hearing. During this period atomic science and engineering were developing with great rapidity. The completion date for the PRDC reactor had been set back, thus allowing more time for research and development. The Chairman of the Advisory Committee on Reactor Safeguards testified at the hearing that although there was not then sufficient proof of its safety to permit a reactor of the type proposed to be operated at Lagoona Beach, it

was "very probable that the necessary information will be obtained" (R. 674). Dr. Harvey Brooks, an ACRS member, testified that there was reasonable assurance that such information would be available in time to meet the PRDC time schedule and that it would furnish the necessary assurance "that the PRDC reactor can be operated at a site such as that proposed without undue hazard to the health and safety of the public." Other ACRS members testified to substantially the same effect (R. 674–75).

3. The Congressional criticism of the handling of the PRDC case which is cited by respondents does not refer to the issues involved in the present case but to the procedure followed in the issuance of the original provisional construction permit. Thus, the material under the heading "Pertinent amendments to the Act after issuance of original construction permit" (Resp. Br. 15–17) is relevant, at most, only to the issuance of the original permit, and has nothing to do with the issues before the Court. Similarly, the colloquy between Senator Anderson and Commissioners Wilson and Olson (Resp. Br. 55–56), in which the Commission's handling of the Fermi project was criticized, related to the original issuance of the permit in 1956, not to the permit here under review. This is also true of the cited Congressional criticism of the Commission's failure to make public the ACRS report (Resp. Br. 61–62), and the statements by Senator Anderson and Representative Holifield criticising the Commission for not having held a hearing before issuing the permit (Resp. Br. 5, n. 5; 61–63).

In short, all of the Congressional criticism that respondents stress so heavily related to an issue not involved in this case—the issuance of the original permit in 1956. The only issue before the Court is the validity of the amended construction permit issued in 1959, and that depends upon what was done in issuing it, not upon what happened in the earlier proceedings involving the superseded permit. Cf. *Inland Empire Council* v. *Millis*, 325 U.S. 697, 706–710; *Federal Broadcasting System* v. *Federal Communications Commission*, 225 F. 2d 560, 563, 564–565 (C.A. D.C.), certiorari denied, 350 U.S. 923.

II

THE COMMISSION'S FINDINGS SATISFIED THE REGULATIONS

Respondents' argument that the Commission's findings satisfy neither the regulations nor the statute rests upon shifting grounds. At times they seem to acknowledge that the findings relate to both the construction and operation of the reactor but contend that the findings are denigrated by the Commission's statement that the findings were made for the purposes of issuing a construction permit (see Brief for Respondents, pp. 11–12, 14–15, 52, 70–71, 72–73, 78–79). At other times they seem to argue that the findings relate only to the construction and not to the operation of the reactor, and, for this reason, fail to satisfy the regulations (see Brief for Respondents, pp. 46–49, 57, 59, 60–61, 72, 78, 80). On still other occasions the argument is apparently based upon a contention concerning the meaning of the

regulations themselves (see Brief for Respondents, pp. 45–50, 53–54, 56, 60, 81).

We deal with these points seriatim.

1. The controlling regulation is Regulation 50.35, under which the Commission was proceeding because PRDC was not in a position to supply all the technical information required to complete the application. The pertinent sentence of Regulation 50.35 provides—

> * * * If the Commission is satisfied that it has information sufficient to provide reasonable assurance that a facility of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public and that the omitted information will be supplied, it may process the application and issue a construction permit on a provisional basis without the omitted information subject to its later production and an evaluation by the Commission that the final design provides reasonable assurance that the health and safety of the public will not be endangered.

After weighing the evidence on the safety of fast breeder reactors, the Commission found (Finding 18, R. 706)—

> (a) It has not been positively established that a fast breeder reactor [of the PRDC type] can be *operated* without a credible possibility of releasing significant quantities of fission products to the environment;
>
> (b) There is reasonable assurance that theoretical and experimental investigations * * * will establish definitively, prior to the sched-

uled completion date of the PRDC reactor, whether or not the reactor proposed by Applicant can be so operated;

(c) There is reasonable assurance that evidence will establish that the reactor proposed by Applicant can be so operated.

These three findings properly focus attention upon what the Commission did, and did not, find in the proceedings leading to the order continuing the PRDC construction permit. The Commission's safety standards are very high. In order to issue an operating license the Commission would have had to find that the PRDC fast breeder reactor, as finally designed, could be operated without a credible possibility of releasing significant quantities of fission products to the atmosphere. The Commission did not make this finding because the proof which further research and experimentation was expected to develop before the completion of the PRDC reactor was not available at the time of the hearing. The Commission did find that there was reasonable assurance that this proof would be available before the operation was licensed (Finding 21, R. 707; Finding 31, R. 710). Indeed, the Commission plainly announced that it would not issue an operating license unless the proof became available (Finding 37, R. 712; R. 676, 679–680, 718–719).

The Commission then went on to discuss the Lagoona Beach site and found that if the expected proof concerning the safety of the reactor became available, Lagoona Beach would be a safe location (Finding 21, R. 707–708).

The Commission then pulled these two groups of findings together into its final conclusion (Finding 22; R. 708)—

> The Commission finds reasonable assurance in the record, for the purposes of this provisional construction permit, that a utilization facility of the general type proposed in the PRDC Application and amendments thereto can be constructed and operated at the location without undue risk to the health and safety of the public.

This finding follows the very words of Regulation 50.35 with two exceptions: (a) the parenthetical phrase "for the purposes of this provisional construction permit" is not in the regulation; and (b) the regulation does not include the specific reference to the PRDC Application.

(a) The phrase quoted above does not denigrate or qualify the finding that there was reasonable assurance that a reactor of the general type proposed could be constructed and operated at the location without undue risk to the public health and safety.

The argument that the parenthetical phrase denigrates the finding ignores both the acknowledged issue before the Commission and the thrust and focus of its entire opinion and findings. Admittedly, the issue was properly framed in terms of Regulation 50.35 in the notice of hearing (R. 576, 578). The issue is also stated in those terms in a portion of the opinion rejecting respondents' legal arguments (R. 645–646). The facts are found in those terms in the opinion (R. 676–677). They are again stated in proper terms in

dealing, first, with the inherent safety of the reactor (R. 706), and, second, with its location (R. 707–708). But then, the respondents say, when the Commission pulled these admittedly proper findings together into the ultimate finding, it suddenly disregarded the regulation and its own prior findings, changed its meaning and, although it used the very language of Regulation 50.35, except for the parenthetical phrase, found something different than what the regulation contemplated.

This is patent nonsense. The phrase modifies the verb "finds." Respondents had been arguing to the Commission that it was prejudging the question whether a license to operate should issue. Respondents were also contending that the evidence would not support the kind of safety finding required for a license. By stating explicitly the limited purpose for which the finding was made the Commission preserved respondents' rights, warned PRDC, and reemphasized the limited character of the question before it.

(b) Respondents erroneously assert that we seek to distinguish between an initial finding of safety with respect to a reactor of the general type proposed and a finding of safety with respect to the operation of the proposed reactor and from this false premise they apparently argue that the Commission's findings are insufficient under Regulation 50.35 because the Act requires a finding as to the operating safety of the proposed reactor.

So far as compliance with the regulations is involved, the short answer is that Regulation 50.35 requires a safety finding concerning "a facility of the

general type proposed." The Commission made the finding with respect to "a utilization facility of the general type proposed in the PRDC Application" (R. 708). The correspondence is exact.

More fundamentally, the fallacy in respondents' argument is that it is a play upon words. In one sense the PRDC application related to a specific reactor—a reactor to be built at Lagoona Beach in accordance with certain specifications. In another sense every reference to the reactor described in the PRDC application covered only a general type because the details of the design had not been frozen and some had not even been tentatively described. So long as the final design remained open, a reference to the PRDC reactor would be specific in the sense that it referred to one identifiable project with certain specifications but it would describe only a class or type of reactor within the definition of which the final design would fall. Phrases like general type depend upon relative specificity and must be construed with reference to the subject matter.

The words "facility of the general type proposed" have been used in the foregoing sense in every Commission proceeding involving a major developmental reactor (see pp. 13–14, 49–61, *infra*). The phrases "facility of the general type proposed" and "final design" draw the contrast between the incomplete information available when an application may be filed and a construction permit is issued; and the minute specification of every detail which must be evaluated before issuing a license to operate. The description in an application for a reactor at a specific location de-

scribes only a general type of reactor so long as a number of final designs might be developed within the scope of the application. This process is still going forward in the PRDC proceeding.

The Commission has consistently granted provisional construction permits for developmental power reactors under Regulation 50.35 on the basis of findings of reasonable assurance of the operating safety of the general type of reactor proposed. In each of the eight other instances in which, up to the time of the decision here under review, the Commission has issued a provisional construction permit for a developmental power reactor, it did so upon the same findings it made here, namely, reasonable assurance that a reactor of the proposed type could be safely constructed and operated at the proposed site.[3] In none of them was the safety finding made in terms of the particular reactor to be constructed. In all of them, as in the instant case, the Commission provided, in accordance with Regulation 50.35, that operating authority would not be granted unless it found, upon completion of construction, that the final design provides reasonable assurance that public health and safety will not be endangered by operation. We have set out, in Appendix A, *infra*, pp. 49–61, excerpts from the construction permits and Commission deci-

[3] As we pointed out in our main brief (pp. 57–69), it is immaterial that in this case the Commission made the finding "for the purposes of this provisional construction permit." That, however, is the sole basis upon which respondents attempt to distinguish the settled Commission practice (Resp. Br. 78–79).

sions in each of the other power reactor cases, which show that safety findings have uniformly been made in the terms of Section 50.35 and, in a majority of the cases (including this one), specific unresolved problems have been identified. In addition, there have been numerous other instances of non-power reactors (where the safety problems generally are not as difficult to solve as in developmental power facilities) in which the Commission, in authorizing construction, has expressly made findings with respect to a reactor of the general type proposed and has provided that an operating license would not issue until safety problems had been successfully resolved.[4]

Even if Regulation 50.35 were far less clear than it is, this settled administrative interpretation by the Commission of its own regulation would be entitled to "controlling weight." *Bowles* v. *Seminole Rock Co.*, 325 U.S. 410, 414.

Respondents point (Br. 53–56) to a proposed revision of Regulation 50.35, published for public comment in February 1960, which would have changed the standard for granting provisional construction permits to "reasonable assurance that the proposed location is suitable from a safety standpoint for a facility of the size (power level in the case of reactors) and general design concept proposed, that the applicant has identified any major features or components on which further research and development

[4] *E.g.*, Westinghouse Electric Co. (Westinghouse Testing Reactor), CPTR-1, July 3, 1957; Georgia Institute of Technology, CPRR-57, June 13, 1960; University of Virginia, CPRR-15, September 13, 1957.

work is needed to determine their acceptability from a safety standpoint, and that the applicant will conduct a research and development program which will investigate the unresolved safety questions" (25 Fed. Reg. 1225). But that revision, which admittedly would have changed the standards presently embodied in Regulation 50.35, was never adopted; and its mere proposal casts no doubt upon the validity of the existing standards under which this permit was issued.

2. At a number of points respondents argue that the Commission's safety findings are insufficient because they relate only to the construction of the PRDC reactor (Brief for Respondents, pp. 57, 59, 72, 78, 80). The opinion and formal findings, however, discuss the safety of both construction *and operation* (R. 676–677, 706, 708). They are focused upon the safety of operation (R. 669–677, 706). A mere reading of the opinion and findings is enough to dispose of respondents' argument upon this point.

3. Respondents' remaining argument to the effect that the Commission's findings do not comply with its own regulations is based upon Regulation 50.40, which appears at pages 135–136 of our main brief. It is headed *"Common Standards"* and lists the "considerations" by which "the Commission will be guided" in determining whether a license should be issued: (a) the processes to be performed, the operating procedures and technical specifications provide reasonable assurance that the applicant will comply with the Commission's regulations and "that the health and safety of the public will not be endan-

gered"; (b) the applicant is technically and financially qualified to engage in the proposed activities, and (c) the issuance of the permit "will not * * * be inimical to the common defense and security or to the health and safety of the public." Respondents point to a passage in the opinion (R. 644) stating that at the construction permit stage of the proceeding these considerations were to be applied to what was being licensed—the construction—and then go on to argue that the Commission should have applied them to what was not then being licensed—actual operation. The argument has two fatal defects.

a. The Commission's opinion and findings, taken as a whole, show that the Commission did in fact guide itself by each of the considerations listed in Regulation 50.40, including the probable safety of operations. Section 50.40 does not require any specific finding about safety of operations at any specific stage in the proceedings leading to a license to operate. It leaves the Commission free to give such weight to the several considerations as it deems appropriate to the particular phase of the proceedings. Section 50.35 is the provision which specifies what findings shall be made, and when they shall be made, in a case involving a provisional construction permit. As shown above, the Commission's safety findings fully satisfy that section.

b. The Commission's interpretation of Regulation 50.40 is consistent with the words and supported by Commission practice. Regulations 50.35 and 50.40 are obviously intended to be consistent and Regulation 50.35, being the more specific, is the controlling pro-

vision with respect to construction permits. The general Section 50.40 covers licenses for different kinds of activities and the very concept of common standards means that the standards will be applied to the thing for which permission is sought—in this case the construction of a reactor.

This interpretation of Section 50.40 of the regulations is supported by the Commission's practice in other cases. We have set forth in Appendix B, *infra*, pp. 62–65, pertinent excerpts from the construction permits and Commission decisions for each of the nine other licensed power reactors showing the Commission's finding under Section 50.40. In none of them was any safety finding made in the terms of Section 50.40(a); in all of them the safety findings were made in terms of Section 50.35. Thus, the Commission obviously views Section 50.35, and not Section 50.40 (a), as governing the issuance of a provisional construction permit. The Commission deemed Section 50.40(b), relating to the applicant's technical and financial qualifications, applicable in all cases, although there are variations in the findings made thereunder. Some of the findings relate to qualification to construct and to operate, others only to construct. Seven of the permits (including the amended PRDC permit) are supported by findings under Section 50.40(c) that the issuance of the construction permit would not be inimical to the common defense and security and to the public health and safety; the remaining three did not make any finding thereunder. Each of the construction permits for these reactors was explicitly subject to the later production of omitted

technical information, yet to be evaluated by the Commission, showing that "the final design provides reasonable assurance that the health and safety of the public will not be endangered." For example, in granting the construction permit for the Yankee reactor at Rowe, Massachusetts, the Commission said—

> The construction permit must be provisional at this stage of the proceeding principally because Yankee has not completed the design of the reactor and certain features of the proposed facility present unresolved questions which might affect its safe operation. * * * [T]he experimental program outlined in the application will probably produce the information needed to resolve these questions prior to consideration of final design and operating procedures and conversion of the construction permit to a license.

For other illustrations see pp. 49–65, *infra*.

Respondents' assertion that a different procedure was followed in the PRDC case rests upon the use of the parenthetical phrase "for the purposes of this "provisional construction permit" in Finding 22. As we have shown above, this phrase does not denigrate or qualify the finding (see pp. 10–11, *supra*). No one can conscientiously deny that the Commission has always followed the two-step procedure in the cases involving developmental power reactors, making a finding before it issued the provisional construction permit of the probability that a safe final design would be developed and reserving a decision upon the safety of the final design until the hearings upon the issuance of a license. A definitive finding on operating safety of the final design has been made at the

time of the construction permit issuance only in cases involving small reactors which are practically production-line items and as to which there are then no unresolved safety problems.

III

THE ATOMIC ENERGY ACT OF 1954 AUTHORIZES REGULATION 50.35 AND THE COMMISSION'S TWO-STEP LICENSING PROCEDURE

We turn now to the central issue—whether Regulation 50.35 and the two-step procedure followed by the Commission are authorized by the Atomic Energy Act of 1954. In our main brief, we showed that the regulation and practice are authorized by Section 104(b), which governs the issuance of licenses, and by the broad rule-making power granted by Section 161 to prescribe regulations necessary "to protect health or to minimize danger to life or property." We also showed that Section 185 foreshadows the two-step procedure.[5]

1. Respondents contend, however, that the substantive standard for the issuance of construction permits is contained in Section 182; and that this section requires the Commission, before authorizing construction, to make a definitive finding as to the operating safety of the proposed reactor. This argument is

[5] The second step of this procedure—the issuance of the operating license—itself may involve several steps. Thus, Regulation 50.57 (10 C.F.R. 50.57, Cum. Supp. 1961) authorizes the issuance of a provisional operating license where "it appears desirable to obtain actual or further operating experience before issuance of an operating license for the full term, up to forty (40) years, requested in the application."

fallacious in three respects: (a) Section 182 does not prescribe the substantive standards governing the granting of licenses, but only the content and form of license applications and related procedures. (b) The provisions of Section 182 upon which respondents rely apply only to operating licenses, and not to construction permits. (c) In any event, the Commission's findings in this case do satisfy the standards of Section 182, if applicable.

a. As pointed out in our main brief (pp. 38–39), the Commission's reactor licensing authority is contained in Sections 103 and 104, in the chapter of the Act entitled "Atomic Energy Licenses"; and it is those sections, rather than Sections 182 or 185, that define the substantive standards for licensing. The latter sections are in the chapter captioned "Judicial Review and Administrative Procedure." Section 182, captioned "License Applications," merely specifies what information all applications for a license must contain and in what form (182(a)), and sets out certain procedures to be followed. Section 185 provides for the issuance of construction permits, and indicates the circumstances in which, upon completion of construction, the Commission is to issue an operating license.

In the case of "applications for licenses to operate production or utilization facilities" (such as the PRDC reactor here involved), Section 182(a) states the requirements for the contents of applications in greater detail than for other licenses. It requires such applicant to submit specified technical material

and such other information as the Commission may deem necessary "to enable it to find that the utilization or production of special nuclear material * * * will provide adequate protection to the health and safety of the public." While this provision requires the furnishing of information upon which the Commission makes findings with respect to public health and safety, the Commission's duty to make such findings flows not from Section 182(a) but ~~from~~ the substantive provisions governing the issuance of licenses. It is to the latter provisions, therefore, that one must look to ascertain what findings the Commission must make and when it must make them. At the very most, the references to findings in Section 182(a) may throw light on the meaning of the provisions which deal with the issuance of licenses and permits; it cannot control them.

The standards for the licensing of all research and development reactor facilities, including authority both to construct and to operate, are contained in Section 104. Section 104(b) authorizes the Commission to issue licenses for developmental power reactor facilities, and provides that in "issuing licenses under this subsection" the Commission shall impose "such regulations and terms of license as will permit the Commission to fulfill its obligations * * * to protect the health and safety of the public." Section 104(d) prohibits the issuance of a license if, in the Commission's opinion, such issuance "would be inimical to * * * the health and safety of the public."

The statutory question in this case, therefore, is not, as respondents phrase it, whether Section 182 rather than Section 185 prescribes the standards for the issuance of construction permits, but whether the findings made by the Commission in the first step of its two-step licensing procedure satisfy the requirements of Section 104. We submit that they clearly do. Congress has given the Commission the broadest discretion to adopt what procedures it deems appropriate "to protect the health and safety of the public." The provisional construction permit system, allowing construction based on findings of reasonable assurance that the type of reactor proposed can be safely built and operated at the site and that remaining safety problems can be resolved, followed by a definitive safety determination before operation is authorized, fully achieves such protection. See our main brief, pp. 36–66.

b. If, contrary to our view, Section 182(a) should be read to prescribe substantive safety standards, still the standards would apply only to licenses to operate, not to licenses to construct. The first sentence of this section provides: "Each application for a license hereunder shall be in writing and shall specifically state such information as the Commission * * * may determine to be necessary to decide * * * qualifications of the applicant as the Commission may deem appropriate for the license." The second sentence, which is the only one referring to findings on public health and safety, provides that, "In connection with applications for *licenses to operate* production or utilization facilities, the applicant shall state * * *" (emphasis added), fol-

lowed by a specification of certain additional information to be furnished. Language could hardly be plainer to indicate that the requirements of the second sentence of Section 182 are applicable only to *licenses to operate* production or utilization facilities, and not to licenses to construct them. Had Congress intended the second sentence to be applicable to licenses to construct, it would either not have limited it to "licenses to operate," or else it would have specifically provided for such broader applicability—as it did in Section 185, which provides for construction permits for "applicants for licenses to construct or modify production or utilization facilities."

A further indication that the second sentence of Section 182 applies only to licenses to operate, and not to licenses to construct, is that it requires the submision of information to enable the Commission to find that "the utilization or production of special nuclear material" will provide adequate protection to public health and safety. "[U]tilization or production of special nuclear material" in a reactor takes place in connection with its operation, not its construction.

Respondents argue (Br. 36), however, that the second sentence of Section 182 must apply to construction permits because the last sentence of Section 185 states that "[f]or all other purposes of this Act, a construction permit is deemed to be a 'license.'" There are two answers:

First, many of the provisions of the Act apply to licenses generally. Other provisions apply to specific

kinds of licenses. The broadest effect which the last sentence of Section 185 can sensibly be given is to make a construction permit the equivalent of a license for the purpose of those provisions which are applicable to licenses generally (*e.g.*, Section 103, 104, 105, 182(b), 182(c), 182(d), 184, 186, 189). Plainly, the sentence does not make the permit the equivalent of any particular kind of license, or of every particular kind of license. And since the second sentence of Section 182(a) applies only to licenses to operate, it is not applicable to licenses generally, and therefore not applicable to a construction permit.

Second, respondents' argument ignores the fact that a construction permit is made the equivalent of a license only "[f]or *all other* purposes of this Act." (Emphasis added.) This must mean purposes other than those of Section 185. It follows that the construction permit is not a license for the purpose of determining whether Section 185 incorporates by reference any substantive standards contained in Section 182 or authorizes the Commission to issue a permit with less complete information than Section 182 would require for the purpose of issuing an operating license. Obviously, Section 185 answers this question by stipulating that the Commission may proceed to issue a permit in the absence of the complete information.

Respondents stress (Br. 33–34), that Section 185 merely provides that, upon completion of construction pursuant to the permit and the satisfaction of certain conditions, the Commission shall issue a "license," but does not specify that it be a license "to

operate." But, in the context of this case, it could be nothing else. In other situations, the license to be issued upon completion of construction may be a license to sell, to transfer, or to export. The significant fact is that Section 185 distinguishes between the initial stage of construction pursuant to a construction permit, and the subsequent stage of operation, sale, transfer or export pursuant to a second, and different, license. It thus supports the Commission's regulation (§ 50.35) providing for different safety findings at the two stages of licensing. See our main brief, pp. 49–52.

Respondents also point out (Br. 31–32) that the second sentence of Section 182(a) specifies, among the information to be furnished in connection with applications for operating licenses, "the place of the use," and that this information ordinarily is needed to describe the facility to be constructed. From this they argue that the second sentence of Section 182 covers licenses to construct. But the fact that information which the statute requires to be submitted in an application for an operating license may also be useful in connection with a construction permit does not establish that a statutory requirement which is limited in terms to "licenses to operate" should be construed to apply to construction permits, and there is nothing inconsistent in the Commission's requiring the same information to be supplied in an application for a construction permit as the statute requires for an operating license.

This conclusion is borne out by the Commission's regulations governing the submission of information

in license applications. The Commission has implemented Section 182(a) by prescribing, in Regulation 50.34, the detailed technical information pertinent to health and safety that must be included in all applications for reactor licenses. If the nature of the proposed reactor is such that complete information can be submitted at the construction permit stage (as is true today for many research reactors), then the applicant can obtain a nonprovisional permit, *i.e.*, the Commission makes the definitive safety findings when it authorizes construction. In such a case, an operating license will ordinarily be issued upon completion of construction merely upon a showing that the construction has been carried out in accordance with the permit.

Where, however, "because of the nature of a proposed project, an applicant is not in a position to supply initially [*i.e.*, in the application for the construction permit] all of the technical information otherwise required" by Section 50.34 for a definitive safety determination, Regulation 50.35 provides for the issuance of a construction permit "on a provisional basis" upon findings of reasonable assurance (1) that a "facility of the general type proposed" can be safely constructed and operated at the proposed site, and (2) that "the omitted information will be supplied" (that is, that the applicant will be able to establish, prior to operation, the safety of the final design).

Thus, the Commission's regulations provide for the submission of the maximum available safety information in an application for a construction permit, and

authorize the granting of a provisional construction permit only where, "because of the nature of a proposed project," all information necessary for a definitive safety determination cannot be then supplied.

c. In any event, if Section 182(a) does provide standards governing the issuance of construction permits, we submit that the Commission's safety findings in this case met those standards.

Section 182(a) merely requires the submission of such information as the Commission may require "to find that the utilization or production of special nuclear material will * * * provide adequate protection to the health and safety of the public." Here the Commission's ultimate finding that a reactor of the general type proposed in the PRDC application can be safely constructed and operated at the location without undue risk to public health and safety (Fdg. 22, R. 708) rested on subsidiary findings of reasonable assurance that, prior to authorizing operation, it can be established that "the proposed reactor" is inherently safe and that "no credible accident can release significant quantities of fission products into the atmosphere" (Fdgs. 21, 18, R. 707–708, 706). In other words, the Commission found reasonable assurance that it will be demonstrated that this reactor can be safely operated.

These subsidiary findings would not have been sufficient to authorize operation, since various health and safety problems still remain to be resolved. But a finding of *future* safe operation, made at the time construction is authorized and several years prior to operation, may be based upon less complete and

definite information than the definitive safety evaluation to be made at the time that operation is authorized. As the Commission stated (R. 679, emphasis in original), "The degree of 'reasonable assurance' with respect to safety that satisfies us in this case for purposes of the provisional construction permit would not be the same as we would require in considering the issuance of the *operating* license."

The Commission thus here found, in substance, that "the utilization * * * of special nuclear material" (in the operation of the reactor) "will provide adequate protection to the health and safety of the public," since it found (Fdg. 18, R. 706, emphasis in original) reasonable assurance that it will be demonstrated "that the reactor proposed by Applicant" "can be *operated* without a credible possibility of releasing significant quantities of fission products [in]to the environment." And the Commission has explicitly provided in the construction permit that it will not grant an operating license unless it "has found that the final design provides reasonable assurance that the health and safety of the public will not be endangered by operation of the facility in accordance with the specified procedures" (R. 718; see, also, R. 679–680, 712).

2. We showed in our main brief (pp. 37, 39–52) that Section 185 sanctions the Commission's settled practice, pursuant to its regulations, of granting a provisional construction permit on findings of reasonable assurance of safe operation of the particular type of reactor proposed, subject to a definitive safety determination after construction and preliminary

testing is completed but before an operating license is issued. We pointed out (*ibid*) that Section 185 provides (1) that a construction permit is to be granted "if the application is otherwise acceptable to the Commission,"[6] and (2) that (a) upon completion of construction, (b) the filing of any additional information needed to bring the original application up to date, (c) upon finding that the facility has been constructed "and will operate" in conformity with the amended application "and in conformity with the provisions of this Act and of the rules and regulations of the Commission," and (d) in the absence of any good cause being shown to the Commission why the granting of a license would not be in accordance with the Act, the Commis-

[6] Respondents distort our position when they state (Br. 35) that we construe Section 185 as providing "no statutory safety standards for, and no limit on the Commission's discretion in regard to, the issuance of construction permits." Our point is that the broad language in Section 185 governing the issuance of construction permits leaves it to the Commission's discretion to select an appropriate method for meeting the basic statutory standard in Section 104 that all licenses must provide adequate protection to public health and safety. In Regulation 50.35 the Commission has provided that an applicant for construction authority, who is unable initially to supply all the technical information necessary for a definitive safety evaluation (as in this case), may be granted a construction permit upon a provisional basis. But such authority is issued only upon finding reasonable assurance that a facility of the proposed type can be safely built and operated, and that the information necessary for an ultimate finding of operating safety of the particular reactor will be supplied. This procedure fully satisfies the standards of Section 104 of adequately protecting the public health and safety. See our main brief, pp. 42–52.

sion shall issue a license. We concluded (Br. 50) that the latter two criteria—operation in conformity with the Act and the rules and regulations, and the "good cause" requirement—were intended to assure that the statutory criteria for safe operation would be met before an operating license is issued.

Respondents contend (Br. 36–39), however, that the "good cause" provision gives the Commission the right to refuse an operating license for safety reasons only if "some objector" raises the issue, and that the third requirement (construction and operation in accordance with the Act and rules and regulations) requires only a finding "that the *terms of the construction permit have been carried out*". (Br. 37, emphasis in original). Since one of the "terms" of every provisional construction permit, including this one (R. 718–719), is that all unresolved safety problems be satisfactorily resolved, respondents' argument falls of its own weight. Furthermore, the requirement of completion of construction in accordance with the permit is only one of two standards in the third condition. The Act requires the Commission to find that the facility has been constructed and will operate not only in conformity with the application, but also "in conformity with the provisions of this Act and of the [Commission's] rules and regulations." Operation in conformity with the Act necessarily means operation consistent with the public health and safety protection standards that the Act contains. Thus, Section 185 requires the Commission, before granting an operating license, to find not only that the construction permit has been com-

plied with, but also that operation of the reactor as built will not be "inimical to * * * the health and safety of the public" (Section 104(d)). The good cause provision further confirms the view that the Commission, before granting an operating license, must find that operation will be safe, since it permits other persons (including members of the Commission's staff or intervenors such as respondents) to bring to the Commission's attention any adverse facts bearing upon operating safety.

In this case, the Commission explicitly stated in the amended construction permit that an operating license will not be issued "unless * * * the Commission has found that the final design provides reasonable assurance that the health and safety of the public will not be endangered by operation of the facility in accordance with the specified procedures" (R. 718); and that, upon completion of construction in accordance with the permit, an operating license will issue only "upon a further finding, after conclusion of additional proceedings, if they be necessary or appropriate, of reasonable assurance of safety of operation" (R. 719). See also Finding 37, which states (R. 712, emphasis in original):

> Proceedings for a license to *operate* the proposed PRDC plant shall be held at a time later to be determined, after the completion of construction. In that proceeding the safety and financial considerations of the PRDC project will be in issue, and we shall again consider whether the PRDC plant can be *operated* with reasonable assurance for the protection of the health and safety of the public.

In short, the Commission has made it explicit that it will not grant an operating license for the PRDC reactor unless it finds that the reactor can be operated safely. As the Commission emphasized in its opinion (R. 646–647, emphasis added): "There can be no doubt that public safety is the first, last, and a permanent consideration in any decision on the issuance of a construction permit *or a license to operate a nuclear facility.*" Section 185 plainly authorizes the Commission to refuse an operating license unless it finds that the reactor can be safely operated, even if construction has been done in full accord with the design presented at the construction permit stage; and Regulation 50.35 provides for a definitive safety determination prior to the grant of an operating license whenever a construction permit is issued on a provisional basis.

The Commission's provisional construction permit procedure, based upon a finding of operating safety of the general type of reactor proposed when construction is authorized, subject to a further definitive safety evaluation of the proposed final reactor design before operation is permitted, provides much greater protection to the public health and safety than respondents' suggestion that all definitive safety findings should be made when the construction permit is issued since the Commission must issue an operating license as long as construction is carried out in accordance with the permit. For under the Commission's two-step procedure the Commission makes its final definitive safety determination on the basis of the latest scientific knowledge and experience

available, including that developed during the construction period. Respondents, however, would require the Commission to base its determination of ultimate operating safety upon information available when construction is first authorized, which may be several years before operation begins. We submit that the strong Congressional concern for safety repeatedly manifested in the Act is clearly furthered by the Commission's settled practice.

3. Neither of the two items of legislative history that respondents cite (Br. 39–44) supports their argument that Section 182 applies to construction permits.

a. The first item—a colloquy between Senator Humphrey and Senator Hickenlooper during which the latter stated that a license and construction permit are equivalent—did not relate to safety matters at all, but to whether the various procedures (such as notice, appellate review and licensing preferences) applicable to the issuance of operating licenses would also be applicable to the issuance of construction permits. See our main brief, pp. 57–61. The proposed amendment of Senator Humphrey, which he subsequently withdrew upon being informed that amendments already made to the bill covered the problem, was that "no construction permits shall be issued by the Commission until after the completion of *the procedures established by section 182* for the consideration of applications for licenses under this act" (100 Cong. Rec. 12014, 3 Leg. Hist. 3759, emphasis added).

The "procedures" of Section 182 to which this proposed amendment related were the giving of notice of license applications and the grant to various public bodies of preferred consideration in licensing, not any "procedures" with respect to the kind of safety findings the Commission must make in issuing construction permits. This is shown not only by the legislative history cited in our main brief, but by the following italicized statement that was omitted from respondents' quotation (Br. 42) from the Senate debate (100 Cong. Rec. 12014, 3 Leg. Hist. 2759):

> Mr. HUMPHREY. * * *
>
> In other words, as I understand, under the bill a construction permit cannot be interpreted in any other way than being equal to or a part of the licensing procedure. Is that correct?
>
> Mr. HICKENLOOPER. The Senator is correct. The staff has worked on this matter. An amendment was offered on, I believe, July 16, to section 189, having to do with hearings or judicial review, and that section was tied up with other sections of the bill. A license and a construction permit are equivalent. They are the same thing, and one cannot operate until the other is granted.
>
> The same is true with reference to hearings. Therefore, we believe, and we assure the Senator, that the amendment is not essential to the problem which he is attempting to reach.
>
> Mr. HUMPHREY. *Let me ask the chairman of the committee if subsection b of section 182, which applies to license applications, also applies to construction permits? Subsection b reads:*

b. The Commission shall not issue any license for a utilization or production facility for the generation of commercial power under section 103, until it has given notice in writing to such regulatory agency as may have jurisdiction over the rates and services of the proposed activity, and until it has published notice of such application once each week for 4 consecutive weeks in the Federal Register, and until 4 weeks after the last notice.

Mr. HICKENLOOPER. *The section does. The answer to the Senator's question is "Yes".*

Mr. HUMPHREY. In other words, the revised sections on judicial review and on hearings and the revised section 182 on license application all apply directly to construction permits?

Mr. HICKENLOOPER. Yes.

Mr. HUMPHREY. With that statement, Mr. President, I withdraw my amendment. The only purpose of the amendment was to clarify that section. I am grateful to the chairman for having done it before the amendment was considered.

The notice requirement referred to in the foregoing italicized statement (now in Section 182(c)) was one of the procedural revisions designed to give greater rights for public bodies which Senator Humphrey and other opponents of the draft bill were able to obtain on the floor of the Senate. It—like the rest of the statements during the debate upon which Respondents rely—had no reference to safety findings, and it affords no support for respondent's conclusion that Congress, by making the procedural provisions of Section 182 and Section 189 applicable to

construction permits, also made applicable the operating safety findings referred to in Section 182.

b. The second item cited (Br. 39–40) is a colloquy from hearings in 1954 involving the testimony of an industry witness, Mr. McQuillen. It appears that Mr. McQuillen was concerned (1) with the administrative burden on an applicant where his proposed activities would, under the bill, require allegedly up to nine different licenses and (2) with what he viewed as the failure of the bill to provide that licensees "would have the assurance that when they had the facility finished in accordance with each of their requirements they would be able to run it." Chairman Cole's comment, cited by respondents, that "undoubtedly" the bill as drawn "would be so operated" does not seem, as respondents contend, to have been directed to the second point, but rather to the first.[7]

[7] Respondents reach their conclusion by omitting to quote that portion of the colloquy which, because it immediately precedes Chairman Cole's interjection, was apparently the statement to which he was directing his attention. This was a statement by Representative Hinshaw:

> Representative HINSHAW. *That seems to me to be reasonable, that you should put all the conditions into 1 license that can be put into 1 license. That would be fair enough.*
>
> Chairman COLE. Would you mind my interruption? Why cannot that be done under the terms of the bill as it is now?
>
> Mr. MCQUILLEN. I think it undoubtedly would be so operated.
>
> Chairman COLE. Of course it would.

[Hearings Before the Joint Committee on Atomic Energy on S. 3323 and H.R. 8862, 83d Cong., 2d Sess., p. 119, 2 Leg. Hist. 1753.]

The problem particularly referred to by Representative Hinshaw was subsequently cleared up by a committee amendment which added Section 161(h) to the bill, authorizing the Com-

In any event, even if the comment had been directed to the second point, the conclusion respondents draw would not follow. The next statement of the witness, in response to Representative Cole's statement, was: "But the terms of the construction-permit section would need a little amendment, I think, to make construction and license at the end of that upon construction as required fit together" (Hearings, fn. 7, *supra*). In other words, the industry witness himself recognized that Section 185 as drafted would not automatically insure an operating license merely because construction was carried out in accordance with the terms of the permit.

4. Respondents challenge (Br. 58–64) our argument (Main Br. 62–66) that Congress has acquiesced in the Commission's two-step provisional construction permit procedure, on the ground that the Commission allegedly never informed Congress that it grants such permits upon finding reasonable assurance of safe operation of the general type of reactor proposed, and defers a definitive safety finding of the final design until the reactor has been construed and is to be licensed to operate. The argument takes various forms. Thus, they contend (Br. 59) that the Commission never informed Congress that its regulations on construction permits require only a finding that construction would not endanger public health and

---

mission to "consider in a single application one or more of the activities for which a license is required by this Act" and to "combine in a single license one or more of such activities". Compare S. 3323, 1 Leg. Hist. 181, 234, with S. 3690, 1 Leg. Hist. 645, 718.

safety. The Commission has never taken that view. It did not take that view in the present case. Here, as in all other provisional construction permit cases, the Commission acted on the basis of findings of reasonable assurance that a reactor of the proposed type could be safely constructed *and operated* at the proposed site (R. 676–77, 706, 708).

Respondents also contend (Br. 60) that the Commission in this case departed from its practice in other provisional construction permit cases (of which Congress was aware), because here the safety findings were made "for the purposes of this provisional construction permit." The argument is entitled to no more weight in this context than it is elsewhere (see *supra*, pp. 10–11, 18, and our main brief, pp. 67–69). Respondents also refer (Br. 60–64) to Congressional criticism of the issuance of the original PRDC permit in 1956. That point, however, has no relevance to the issue before this Court: the validity of the amended permit issued in 1959. See *supra*, pp. 3–7. And it was the procedure followed in issuing such amended permit that the Commission brought to the attention of Congress.

If, despite the material set forth in our main brief (pp. 62–66), there were any doubt as to whether the Commission had informed Congress as to the basis upon which it issues provisional construction permits, such doubt is dispelled by the very Commission statement that respondents quote at page 60 of their brief. The Commission there advised the Joint Committee that—

> The Commission staff reviews these reports as they are submitted, holds informal meetings

> with the applicant, discusses the safety aspects of the reactor with its advisers (ACRS), considers the progress of the developmental programs which are being carried out by the applicant, and *finally arrives at a point when it believes that there is reasonable assurance that the unresolved safety problems can be resolved* in a way that will make it possible for the applicant to operate the proposed reactor at the proposed site without undue risk to the health, safety, and property of the public. *At this juncture,* the Commission may issue a conditional construction permit. [Emphasis added]

If respondents' claim is that the Commission's reporting to Congress was insufficient to show acquiescence by the latter because the Commission never specifically used the precise terminology of Regulation 50.35 ("a facility of the general type proposed"), the short answer is that it did. On May 15, 1956, the then general manager of the Commission advised the Joint Committee (Hearings Before the Joint Committee on Atomic Energy on Governmental Indemnity for Private Licensees and AEC Contractors against Reactor Hazards, 84th Cong., 2d Sess., pp. 62–63, emphasis added):

> * * * We have established procedures whereby the applicant may submit the results of his hazard evaluation step by step as a series of preliminary hazard summary reports. At such a time as we are satisfied that we have *information sufficient to provide reasonable assurance that a facility of the general type pro-*

posed can be constructed and operated at a proposed location without undue risk to the health and safety of the public, we can issue a construction permit for the facility. Such a permit is, of course, conditional and will not convert to a license to operate until the complete hazard summary report has been submitted, and we have made a finding based thereon that the final design of the specific facility provides reasonable assurance that the health and safety of the public will not be endangered by operation of the reactor in accordance with specified procedures.

This is the type of construction permit that we will probably have to issue for all of the power demonstration reactors, and even for many of the research, testing, and medical reactors, for the next few years.

The foregoing statement is an exact description of the procedure followed by the Commission in this very case.

The two Joint Committee staff studies of the Commission's regulatory program have similarly shown full knowledge of the basis upon which the Commission issues provisional construction permits. Joint Committee on Atomic Energy, *A Study of AEC Procedures and Organization in the Licensing of Reactor Facilities,* 85th Cong., 1st Sess. (Joint Committee Print 1957), pp. 6, 96, 107–108; Joint Committee on Atomic Energy, *Improving the AEC Regulatory Process,* 87th Cong., 1st Sess. (Joint Committee Print 1961), Vol. 1, p. 31, Vol. 2, p. 154. Moreover, the Commission sends copies of all construction permits and its decisions thereon to the Joint Committee.

IV

RESPONDENTS' ASSERTIONS AS TO THE SAFETY HAZARDS OF ATOMIC REACTORS GENERALLY AND OF THE PRDC REACTOR IN PARTICULAR ARE CONTRARY TO THE FACTS

Respondents make numerous unsupported and unwarranted statements with respect to the operating safety hazards of atomic reactors generally and the PRDC reactor in particular. For example, after noting the government's statement in its brief that there had been only one fatal reactor accident in this country, on January 3, 1961, they state (Br. 15) that "many reactor accidents have occurred, some causing serious injuries to reactor personnel and undetermined injuries to the surrounding population." In support of this statement, they cite a four-page "List of Reported Atomic Reactor Accidents" contained in the appendix to their brief, pp. 105–108). We have set forth in Appendix C, *infra,* pp. 66–91, a detailed description and explanation of each of the alleged "accidents" in the United States, and of those elsewhere for which information is available, prepared by the Commission's Division of Licensing and Regulation.

This material shows that, contrary to respondents' statement, reactors have indeed been operated in the United States with a "remarkable safety record" (R. 879). Of the 22 "accidents" in this country cited by respondents, only one (to which we previously referred) involved any fatalities, and that one resulted in the death of three operators inside the reactor building. Three resulted in overexposure of

operating employees to radiation, with no reported injuries. Several others caused a temporary increase in radiation levels in the facilities which, however, did not result in overexposure of any persons.[8] The remaining 13 "accidents" involved only various difficulties in operation, ranging from corrosion of a component, requiring replacement, to damage to the reactor. While these may have necessitated cleanup and maintenance work, they did not present hazard to operating personnel or to the public. None of the incidents involved any person not employed in the reactor itself.

We recognize, of course, that an atomic reactor accident, if it should occur, might cause serious public injury. But it is precisely because of this danger that such extraordinary safety precautions are taken in this industry. The Commission's elaborate health and safety program is based upon a full recognition of the dangers and, also, of the means available to prevent any injurious consequences. Atomic reactors may yet be a mystery to the average layman. But there is a wealth of scientific information which teaches that this new source of controlled energy can be, and

[8] Part 20 of the Commission's regulations prescribes the applicable radiation exposure limits—permissible radiation levels and concentrations of radioactive material for persons in restricted areas, *i.e.*, employees in atomic energy facilities, and for unrestricted areas accessible to the public. These limits, based in part upon long-term experience with X-rays and radium, provide substantial margins of safety to permit continuous exposure without deleterious effects. The Commission's regulations conform to the Recommendations of the National Committee on Radiation Protection, National Bureau of Standards Handbooks 59 (1954, Supp. 1958), 69 (1959).

is being, safely utilized for beneficial ends. Statistics show, as one well-known commentator in the atomic energy field (Professor Estep of the University of Michigan Law School) recently stated (Estep, *Radiation Injuries and Statistics: The Need for a New Approach to Injury Litigation,* 59 Mich. L. Rev. 259, 260) that:

> An amazing safety record has been achieved by the nuclear industry so far and enough is known about radiation safety to support an argument that it is safer to handle radiation than many other types of material which industrialized countries have been using for decades. * * *.

While accident statistics are not available for those engaged in the operation of atomic reactors as such, the Commission has statistics showing the accident rate in its own installations. For the year 1960, this was 1.68 disabling injuries per million man-hours worked. This is far below the National Safety Council's industry-wide average for 1959 (the latest figures available) of 6.47 injuries per million man-hours worked. Only one industry reported by the National Safety Council had a lower rate than the Commission's installations: communications, with .96 injuries. The Commission's accident rate is lower than that in such industries as aircraft manufacturing (2.01), chemicals (3.32), textiles (4.34), printing and publishing (5.52), tobacco (6.50), pulp and paper (7.44), meat packing (8.20), and air transport (15.33). In terms of days lost per million man-hours worked, the Commission's 1960 record of 198 is far below the

industry-wide average of 754, and is bettered by only four industries (communications, wholesale and retail trade, electrical equipment, and storage and warehousing). Accident Facts, 1960 edition, published by the National Safety Council, Chicago, Ill., p. 26; AEC Press Release D–72, March 30, 1961.

Sir John Cockroft, a prominent British physicist to whose statements respondents refer (Br. 7, n. 7),[9] recently stated that the working force of more than 30,000 persons in Great Britain's atomic power industry has suffered no ill effects from radiation. New York Times, April 7, 1961, p. 12.

With respect to the safety hazards of this particular reactor, respondents, citing a recent motion filed by PRDC with the Commission requesting an extension of time for completion of construction, state (Br. 9) that PRDC has not yet solved its bowing problem, *i.e.*, the danger that fuel elements may bend toward each other, causing nuclear instabilities. That motion itself, however, and other public documents filed by PRDC, indicate that it believes that the bowing problem has been solved.[10] Moreover, the experiments that

[9] Respondents refer (Br. 7, n. 7) to a statement by Sir John that an accident in Britain's Windscale reactor in 1957 released more radio-activity than is released during an explosion of an atomic bomb of the Hiroshima type. In the Windscale accident, a release and dispersal of fission products into the atmosphere resulted not from an explosion, but from a fire in the graphite moderator (which PRDC will not have) and from the absence of gas-tight containment (which PRDC will have). There were no reported injuries from the Windscale accident. See *infra*, pp. 83–84.

[10] PRDC's Eighth Quarterly Technical Report, dated September 10, 1960; PRDC Application for Extension of Construction Permit, dated October 28, 1960.

have been conducted since the decision in this case at the Commission's Experimental Breeder Reactor No. 1 have apparently confirmed that the problem is soluble, as the Commission anticipated (R. 672, 704).[11] In any event, the Commission has made it clear that PRDC will not receive a license to operate until it has demonstrated that the bowing problem has been solved (R. 676, 712, 718–719).

Respondents also refer (Br. 8, n. 8) to a recent statement in a periodical that the "maximum credible accident" for the PRDC reactor has not been defined. The Commission stated in this case that it requires applicants to identify the worst accident deemed credible, so that the Commission can evaluate it and determine "whether the worst accident deemed credible can have hazardous consequences to the public," and that PRDC had not yet done so (R. 678–679). The Commission made it explicit, however, that it would not issue an operating license until this evaluation had been made and it is shown that the reactor can be safely operated. While the maximum "credible accident" may not have yet been determined, this does not mean that there are no known limits to a possible accident in the PRDC reactor. Indeed, Dr. Bethe discussed "incredible accidents" and the safeguards against them (R. 765–767).

[11] Argonne National Laboratory Summary Status of Fast Breeder Reactor Program, dated December 1, 1960. This technical report, filed by the AEC Staff, and the PRDC report cited in the preceding footnote, have been incorporated in the public record of this proceeding and served upon all parties, pursuant to Commission Order (R. 711–714).

V

THE COMMISSION'S FINDINGS ON THE SAFETY OF THE SITE ARE ADEQUATE

Respondents make no attempt to defend the ruling below (R. 964) that "the Commission's safety findings are deficient in an additional respect," namely, that although "Congress intended no reactor should, without compelling reasons, be located where it will expose so large a population to the possibility of a nuclear disaster * * *, * [i]t does not appear that the Commission found compelling reasons or saw that such reasons were necessary." Instead, they argue (Br. 87) that all the court really meant was that "the most compelling reasons are not a substitute for sufficient safety findings concerning the reactor itself." [12] Their discussion of this issue is primarily an attack upon the sufficiency of the Commission's findings as to the safety of this particular site.

Respondents contend that the Commission did not "relate * * * the site problem to population density" (Br. 83). Finding 19 (R. 707), however, expressly states the population distribution within various distances from the site, ranging from one to thirty miles, and recognizes that during the summer months the population within five miles would be increased due to vacationing transients and people visiting beaches. The Commission's ultimate finding (R. 708) of reasonable assurance that a reactor of this type can be constructed and operated "at the location"

[12] Respondents' further contention (Br. 87) that the ruling is dictum is refuted by the opinion itself.

without undue risk to public health and safety was thus made in the light of the population density in the area. There is no basis for respondents' contention (Br. 85) that the Commission "actually rejected" "population density" in making its safety findings, merely because it did not repeat the language of the finding in the initial decision that referred to "the population density around the site" (R. 614).

Respondents also refer (Br. 88–90) to the Commission's proposed regulations on Reactor Site Criteria, published on February 11, 1961, 26 F.R. 1224, and suggest that the Commission has "belatedly" changed its policy to consider population densities near reactor sites. On the contrary, as the Commission explained in recent Congressional hearings, and as the regulations themselves indicate, the published criteria do not represent a departure from prior practice, but are a publication and crystallization of the criteria which the Commission has regularly applied to reactor location. Hearings on Development, Growth, and State of the Atomic Energy Industry, before the Joint Committee on Atomic Energy, 87th Cong., 1st Sess., p. 103 (stenographic transcript).

Indeed, respondents themselves concede (Br. 89) that the location of the PRDC reactor would be acceptable under the published criteria. This can be shown from the proposed regulations. Sample figures are presented for appropriate distances from population centers, given according to reactor power level, which can be utilized as an "initial estimate" for a particular reactor. (10 C.F.R. 100.11(b), 26 F.R. 1225.) The figures vary from 0.7 miles for a reactor

of 10 thermal megawatts, 6 miles for a reactor of 300 thermal megawatts (the size of PRDC), and up to 17.7 miles for a reactor of 1500 thermal megawatts. The PRDC reactor, however, will be located 25 miles from Toledo and 30 miles from Detroit. Even under the Commission's qualifications that distances may have to be greater from very large cities, and for reactors with novel design features (which respondents stress), there is no reason to doubt that the PRDC site is well within the proposed standards.

CONCLUSION

For the foregoing reasons, and for those set forth in our main brief, the judgment of the court of appeals should be reversed.

Respectfully submitted.

ARCHIBALD COX,
Solicitor General.

WILLIAM H. ORRICK, Jr.,
Assistant Attorney General.

DANIEL M. FRIEDMAN,
Assistant to the Solicitor General.

MORTON HOLLANDER,
Attorney.

NEIL D. NAIDEN,
General Counsel,

COURTS OULAHAN,
Deputy General Counsel,

LIONEL KESTENBAUM,
Attorney,
Atomic Energy Commission.

APRIL 1961.

APPENDIX A

EXCERPTS FROM CONSTRUCTION PERMITS ISSUED FOR POWER REACTORS AND ACCOMPANYING COMMISSION DECISIONS RELATED TO SAFETY FINDINGS UNDER SECTION 50.35 OF THE COMMISSION'S REGULATIONS.

1. *Consolidated Edison Company of New York, Inc.*, Construction Permit No. CPPR–1 issued May 4, 1956:

"The Atomic Energy Commission (hereinafter the 'Commission') has found that: * * *

"E. Consolidated has submitted sufficient information to provide reasonable assurance that a utilization facility of the general type proposed by Consolidated can be constructed and operated at the proposed location without undue risk to the health and safety of the public and that additional information required to complete its application will be supplied.

* * * * * *

"(4) This permit is subject to submittal by Consolidated to the Commission (by proposed amendment of the application) of the complete, final Hazards Summary Report (~~portions of which~~ may be submitted and evaluated from time to time) and a finding by the Commission that the final design provides reasonable assurance that the health and safety of the public will not be endangered by operation of the reactor in accordance with the specified procedures."

2. *Commonwealth Edison Company,* Construction Permit No. CPPR–2, issued May 4, 1956:

"The Atomic Energy Commission (hereinafter the 'Commission') has found that: * * *

"(E) Commonwealth has submitted sufficient information to provide reasonable assurance that a utilization facility of the general type proposed by Commonwealth can be constructed and operated at the proposed location without undue risk to the health and safety of the public and that additional information required to complete its application will be supplied.

* * * * *

"(4) This permit is subject to submittal by Commonwealth to the Commission (by proposed amendment of the application) of the complete, final Hazards Summary Report (portions of which may be submitted and evaluated from time to time) and a finding by the Commission that the final design provides reasonable assurance that the health and safety of the public will not be endangered by operation of the reactor in accordance with the specified procedures."

3. *General Electric Company*, Construction Permit No. CPPR–3, issued May 14, 1956:

"The Atomic Energy Commission (hereinafter the 'Commission') has found that: * * *

"E. GE has submitted sufficient information to provide reasonable assurance that a utilization facility of the general type proposed by GE can be constructed and operated at the proposed location without undue risk to the health and safety of the public and that additional information required to complete its application will be supplied.

* * * * *

"(4) This permit is subject to submittal by GE to the Commission (by proposed amendment of the application) of the complete, final Hazards Summary Report (portions of which may be submitted and

evaluated from time to time) and a finding by the Commission that the final design provides reasonable assurance that the health and safety of the public will not be endangered by operation of the reactor in accordance with the specified procedures."

4. *Power Reactor Development Company,* Construction Permit No. CPPR–4, as amended, is set forth at R. 715, the Commission's decision at R. 630.

5. *Yankee Atomic Electric Company,* Construction Permit No. CPPR–5, issued November 4, 1957:

"E. The applicant may proceed to design and construct the proposed reactor without further authorization in accordance with the application and amendments thereto. However, this does not constitute final approval of any technical specification of the reactor. Before the license is issued to operate the facility, the Commission must finally approve all technical specifications. If the applicant desires final approval of any particular technical specification prior to the issuance of the license to operate, he may request that the Commission grant specific approval of any technical specification by appropriate amendment to this permit.

"This permit is provisional to the extent that a license authorizing operation of the reactor will not be issued by the Commission unless Yankee has submitted to the Commission (by proposed amendment to the application) the complete, final Hazards Summary Report (portions of which may be submitted and evaluated from time to time) and the Commission has found that the final design provides reasonable assurance that the health and safety of the public will not be endangered by operation of the reactor in accordance with the specified procedures."

The Commission's Order dated October 31, 1957, directing issuance of the permit, stated:

"IT IS FOUND THAT: * * *

"D. There is sufficient information to provide reasonable assurance that a reactor of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public; and that additional information required to complete the application will be supplied.

"The Commission believes that the applicant has identified the subjects which should be further investigated and that the plans described for carrying out these investigations will produce the information which will be needed prior to consideration of final design and operating procedures and conversion of this construction permit to a license."

The Commission's accompanying Memorandum of Opinion stated:

"The reactor will be a pressurized water reactor generally similar to the pressurized water reactor (PWR) now nearing completion at Shippingport, Pennsylvania. Considerable information and experience have been acquired from the design and operation of pressurized water reactors by the Commission and the Department of Defense. Additional information and experience will be gained from continued operation of these reactors, and from the design and operation of other pressurized water reactors, prior to completion of the Yankee reactor. The accumulated experience and information now available as to such reactors, together with the information contained in the application, warrant the conclusion that there is at the present time reasonable assurance that a facility of the type proposed by Yankee can be constructed and operated at the proposed location without undue risk to the health and safety of the public. Accordingly, we have decided to authorize issuance of a construction permit to Yankee on a provisional basis pursuant to Section 50.35 of our regulations.

"The construction permit must be provisional at this stage of the proceeding principally because Yankee has not completed the design of the reactor and certain features of the proposed facility present unresolved questions which might affect its safe operation. These features have been identified and discussed in the testimony furnished at the hearing by Dr. Clifford K. Beck, Chief of the Hazards Evaluation Branch and in the report of the Advisory Committee on Reactor Safeguards.* We agree with Dr. Beck and the Advisory Committee that the experimental program outlined in the application will probably produce the information needed to resolve these questions prior to consideration of final design and operating procedures and conversion of the construction permit to a license."

6. *Saxton Nuclear Experimental Corporation,* Construction Permit No. CPPR–6, issued February 11, 1960:

"1. * * * D. The applicant may proceed to design and construct the facility described in the application and amendments thereto without further authorization. However, this does not constitute final approval of any technical specification of the facility as distinguished from the general design concept proposed. Before the license is issued to operate the facility, the Commission must finally approve all technical specifications. If the applicant desires final approval of any particular technical specification prior to the issuance of the license to operate, he may request that the Commission grant specific approval of any tech-

* "As identified in the testimony of Dr. Beck and in the report of the Advisory Committee on Reactor Safeguards, these questions include:

"1. The addition of neutron absorbers;

"2. Intentional design into the reactor of nucleate boiling; and

"3. Large plutonium build-up." (Commission's footnote.)

nical specification by appropriate amendment to this permit.

"2. This permit is provisional to the extent that a license authorizing operation of the facility will not be issued by the Commission unless Saxton Nuclear Experimental Corporation has submitted to the Commission (by amendment to the application) the complete, Final Hazards Summary Report (portions of which may be submitted and evaluated from time to time) and the Commission has found that the final design provides reasonable assurance that the health and safety of the public will not be endangered by operation of the facility in accordance with the specified procedures."

The Hearing Examiner's Intermediate Decision, issued January 21, 1960: *

"Conceptual design and design criteria for the major components of the facility have been developed in considerable detail in Saxton's application and in testimony at the hearings. Although detailed engineering design of the Saxton reactor is not complete, the information provided, as partly summarized hereafter, supports the conclusion that there is reasonable assurance that the Saxton reactor can be satisfactorily designed and safely operated. After all engineering details of the plant have been settled, Saxton will submit additional information to the Commission as an amendment to its application for construction permit in the form of a final hazards summary report, which information will be considered at the hearing on the operating license.

* * * * *

*The decisions of hearing examiners, cited in Appendices A and B, became final decisions of the Commission in the absence of exceptions by the parties or review by the Commission on its own motion.

"4. Sufficient information has been presented to provide reasonable assurance that a nuclear reactor of the general type described in the application and Preliminary Hazards Summary Report can be constructed and operated at the proposed location without endangering the health and safety of the public.

* * * * *

"6. There is reasonable assurance that technical information omitted from, and required to complete, the application will be supplied."

7. *Carolinas-Virginia Nuclear Power Associates, Inc.*, Construction Permit No. CPPR–7, issued May 4, 1960:

"C. This permit authorizes the applicant to construct the facility in accordance with the application and amendments thereto heretofore filed in this proceeding without further authorization.

"D. If the applicant desires Commission approval of any particular technical specification (such as the use of Zircaloy for pressure tubes), prior to consideration of a license to operate, it may request that the Commission grant specific approval of any technical specification by appropriate amendment to this permit.

"E. This permit is provisional to the extent that a license authorizing operation of the facility will not be issued by the Commission until evidence has been adduced by Carolinas Virginia Nuclear Power Associates, Inc. concerning the tests performed of all designs and components of this proposed utilization facility, including, among others, specially designed use of heavy water, the U-pressure tubes, and their use of Zircaloy, and a basis has thereby been established as to all components when operated as a unit, that there is adequate protection to the health and safety of the public as required by the Atomic Energy

Act, as amended, and by the rules and regulations of the Commission."

The Hearing Examiner's Intermediate Decision, issued April 12, 1960:

"The final design of the reactor has not been completed; but criteria for its major components have been developed in considerable detail in the evidence produced in this proceeding. Present analyses and calculations from these preliminary design parameters indicate that no particularly unfavorable safety characteristics will arise from the nuclear, thermal, or hydraulic features of the reactor. The research and development program now being conducted by CVNPA, supplemented by the experience of similar reactors operating earlier than the reactor, affords reasonable assurance that the presently unresolved safety questions concerning its unproved features can be answered and thus assure that the reactor can be satisfactorly designed and safely operated. The final design criteria will evolve from the full-scale critical experiments which will begin in the spring of 1960. After all of the engineering details of the nuclear plant have been settled, CVNPA will submit additional information to the Commission as an amendment to its License Application in the form of a final hazards summary report.

"As will be provided hereinafter, in view of the untested character of certain components, and new design problems involved in this nuclear reactor, conditions will be attached to this construction permit requiring proof by tests of the adequacy and safety of the pressure U-tubes, specially designed for the use of heavy water and the zircaloy clad fuel elements, before this construction permit may be converted to an operating license. This evidence will be additional to that presented as the basis for opinions that the completed project has been constructed in accord-

ance with the specifications of this construction permit and will provide reasonable assurance that the health and safety of the public will not be endangered by its operation.

* * * * *

"3. There is sufficient information to provide reasonable assurance that the utilization facility of the general type proposed in the application, as amended, by CVNPA can be constructed at the location specified therein without endangering and will provide adequate protection to the health and safety of the public.

"4. There is reasonable assurance that the technical information omitted from and required to complete the application, including particularly that related to the special designed use of heavy water, the U-pressure tubes, and the use of zircaloy cladding of the fuel elements, will be supplied."

8. *Northern States Power Company,* Construction Permit No. CPPR–8, issued May 12, 1960:

"C. This permit authorizes the applicant to construct the facility in accordance with the application and amendments thereto heretofore filed in this proceeding without further authorization.

"D. If the applicant desires Commission approval of any particular technical specification (such as the design details of the various components and special design features, including the nuclear superheater, the aluminum alloy fuel elements, and circulation control system), prior to consideration of a license to operate, it may request that the Commission grant specific approval of any technical specification by appropriate amendment to this permit.

"E. This permit is provisional to the extent that a license authorizing operation of the facility will not be issued by the Commission until the proposed research and development program has been completed

and evidence has been adduced by Northern States Power Company and it has been found by the Commission, that the Northern States Power Company's proposed nuclear utilization facility, including among other components which must be proven acceptable by tests described in the Intermediate Decision dated April 21, 1960, the novel features respecting the fuel elements in the boiler region of the core, the incorporation of a superheater with unproven types of fuel elements as an integral part of the basic reactor core, and the proposal that a variable rate of primary coolant recirculation be utilized for controlling the power level of the core, has been constructed and can we operated with adequate protection to and without endangering the health and safety of the public in accordance with the requirements of the Atomic Energy Act, as amended, and by the Rules and Regulations of the Commission."

The Hearing Examiner's Intermediate Decision, issued April 21, 1960:

"As stated, the proposed facility is a boiling water reactor having several new features and unique characteristics with which there has been no previous experience in any other reactor of a size comparable to that proposed by NSP. These are the use of aluminum alloy as a cladding for fuel in the boiler core, the use of cermet fuel of the type proposed to be used and the superheater core, and the variable rate of primary coolant recirculation proposed to be used for controlling the power level of the core.

* * * * *

"For the purposes of an operating license, both NSP and the Staff are agreed that further analysis and research and development explorations must be conducted before a judgment can be made that the superheater, the aluminum cladding, and the recircu-

lation rate of the primary coolant can be safely incorporated into this particular reactor.

* * * * *

"3. There is sufficient information available to provide reasonable assurance that the utilization facility of the general type proposed in the application, as amended, by NSP can be constructed and operated at the location specified therein without endangering and will provide adequate protection to, the health and safety of the public.

"4. There is reasonable assurance that, in accordance with (1) research and development programs outlined in the evidence, (2) the tests proposed to be undertaken of the components, and (3) the availability of proven features to be incorporated in the reactor should necessity therefore require, the technical information omitted from the application will be supplied, including particularly that related to fuel elements to be utilized in the boiler region of the core, the nuclear superheater and its fuel elements proposed to be incorporated as an integral part of the basic reactor core, and the controls of the variable rate of primary coolant recirculation."

9. *Consumers Power Company,* Construction Permit No. CPPR–9, issued May 31, 1960:

"C. This permit authorizes the applicant to construct the facility in accordance with the application and amendments thereto heretofore filed in this proceeding without further authorization.

"D. If the applicant desires Commission approval of any particular technical specification, prior to consideration of a license to operate, it may request that the Commission grant specific approval of any technical specification by appropriate amendment to this permit.

"E. This permit is provisional to the extent that a license authorizing operation of the facility will not be issued by the Commission unless Consumers Power Company has submitted to the Commission (by amendment to the application) the complete Final Hazards Summary Report (portions of which may be submitted and evaluated from time to time) and the Commission has found that the final design provides reasonable assurance that the health and safety of the public will not be endangered by operation of the facility in accordance with the specified procedures.

The Hearing Examiner's Intermediate Decision, issued May 6, 1960:

"The determination of the existence of reasonable assurance that the utilization facility can be constructed and operated at the proposed site without undue risk to the health and safety of the public is limited by the present record to the conventional type of boiling water reactor with a power density of 30 kilowatts per liter. Many details of the design of Consumers' project remain to be completed. The Staff of the Commission has expressed the view that while it is believed that experiments will develop satisfactory designs, it remains to be demonstrated that the maximum specific power densities proposed can be safely achieved, and that clarification must be provided on the need for in-core instrumentation which may appear to be necessary as performance parameters are better understood. The adequacy of the control rod drive mechanisms may warrant re-examination at a later stage in the design calculations.

* * * * *

"3. There is sufficient information available to provide reasonable assurance that the utilization facility of the general type proposed in the application by Consumers can be constructed and operated at the

location specified without endangering and will provide adequate protection to the health and safety of the public.

"4. There is reasonable assurance that, in accordance with the research and development programs outlined in the evidence and the availability of alternate proven features to be incorporated in the reactor should necessity therefore require, the technical information omitted from the application will be supplied."

10. *Pacific Gas & Electric Co.*, Construction Permit No. CPPR–10, issued November 9, 1960:

"C. This permit authorizes the permittee to construct the facility in accordance with its application, as amended, and as described in the hearing record in this proceeding, without further authorization.

"D. If the permittee desires Commission approval of any particular technical specification or modification, prior to consideration of a license to operate, it may request that the Commission grant specific approval thereof, by appropriate amendment to this permit."

The Hearing Examiner's Intermediate Decision, issued October 17, 1960:

"Issue (1) The applicant has submitted sufficient information to provide reasonable assurance that a utilization facility of the general type proposed in the application can be constructed and operated at the proposed location without undue risk to the health and safety of the public;

"Issue (2) There is reasonable assurance that the technical information omitted from and required to complete the application will be supplied."

The further finding with respect to "the nuclear power reactor facility which is proposed" and the reservation on certain safety questions, were discussed in our main brief, p. 44, fn. 12.

APPENDIX B

EXCERPTS FROM CONSTRUCTION PERMITS ISSUED FOR POWER REACTORS AND ACCOMPANYING COMMISSION DECISIONS RELATED TO SECTION 50.40 OF THE REGULATIONS

1. *Consolidated Edison Company of New York, Inc.*, Construction Permit No. CPPR–1:

"C. Consolidated is financially qualified to assume responsibility for the payment of Commission charges for the special nuclear material to be furnished by the Commission, to undertake and carry out the proposed use of the material for a reasonable period of time, and to construct and operate the reactor in accordance with the regulations contained in Title 10, Chapter 1, C.F.R.

"D. Consolidated and the Babcock & Wilcox Company, the contractor selected by Consolidated to design and construct said reactor, are technically qualified to design and construct the reactor."

2. *Commonwealth Edison Company,* Construction Permit No. CPPR–2:

"C. Commonwealth is financially qualified to assume responsibility for the payment of Commission charges for the special nuclear material to be furnished by the Commission, to undertake and carry out the proposed use of the material for a reasonable period of time, and to construct and operate the reactor in accordance with the regulations contained in Title 10, Chapter 1, C.F.R.

"D. Commonwealth and General Electric Company, the contractor selected by Commonwealth to design and construct said reactor, are technically qualified to design and construct the reactor."

3. *General Electric Company,* Construction Permit No. CPPR–3:

"C. GE is financially qualified to construct and operate the reactor in accordance with the regulations contained in Title 10, Chapter 1, C.F.R.; to assume financial responsibility for the payment of Commission charges for special nuclear material and to undertake and carry out the proposed use of such material for a reasonable period of time.

"D. GE is technically qualified to design and construct the reactor."

4. *Power Reactor Development Company,* Construction Permit No. CPPR–4, as amended is set forth at R. 715, the Commission's decision at R. 630.

5. *Yankee Atomic Electric Company,* Construction Permit No. CPPR–5.

The Commission Order, October 31, 1957, states:

"C. Yankee and its contractors, Westinghouse Electric Corporation and Stone & Webster Engineering Corporation, are technically qualified to design and construct the proposed reactor.

* * * * *

"E. The issuance of a construction permit to Yankee will not be inimical to the common defense and security or to the health and safety of the public."

6. *Saxton Nuclear Experimental Corporation,* Construction Permit No. CPPR–6.

The Hearing Examiner's Intermediate Decision states:

"3. Westinghouse Electric Corporation is technically qualified to design and construct the reactor, and accordingly, Saxton has provided for adequate technical qualifications to design and construct the proposed facility.

* * * * *

"5. Saxton is financially qualified to design and construct the proposed facility.

* * * * *

"7. The issuance of a construction permit to Saxton will not be inimical to the common defense and security or to the health and safety of the public."

7. *Carolinas Virginia Nuclear Power Associates, Inc.,* Construction Permit No. CPPR–7.

The Hearing Examiner's Intermediate Decision states:

"5. CVNPA, Westinghouse, and Stone & Webster, collectively, are technically qualified to design and construct the proposed utilization facility.

"6. CVNPA is financially qualified to engage in the proposed activities in accordance with the Atomic Energy Act, as amended, and the rules and regulations of the Commission.

"7. The issuance of the proposed construction permit to CVNPA, substantially in the form attached to the Notice of Hearing issued herein, as modified by the order hereinafter made, will not be inimical to the common defense and security or to the health and safety of the public."

8. *Northern States Power Company,* Construction Permit No. CPPR–8.

The Hearing Examiner's Intermediate Decision states:

"5. NSP and Allis-Chalmers Manufacturing Company, collectively are technically qualified to design, construct, and operate the proposed utilization facility.

"6. NSP is financially qualified, and as supplemented by contributions from associated electric utilities is able to engage in the activities proposed in its application in accordance with the Atomic Energy

Act, as amended, and the Rules and Regulations of the Commission.

"7. The issuance of the proposed construction permit to NSP, substantially in the form attached to the Notice of Hearing issued herein, as modified by the Order hereinafter made, will not be inimical to the common defense and security or to the health and safety of the public."

9. *Consumer Power Company,* Construction Permit No. CPPR–9.

The Hearing Examiner's Intermediate Decision states:

"5. Consumers, General Electric Company, and Bechtel Corporation, collectively, are technically qualified to design, construct, and operate the proposed utilization facility.

"6. Consumers is financially qualified and able to engage in the activities proposed in its application in accordance with the Atomic Energy Act, as amended, and the Rules and Regulations of the Commission.

"7. The issuance of the construction permit in substantially the form attached hereto will not be inimical to the common defense and security, nor to the health and safety of the public."

10. *Pacific Gas and Electric Company,* Construction Permit No. CPPR–10.

The Hearing Examiner's Intermediate Decision states:

"Issue (3) The applicant, collectively with General Electric Company and Bechtel Corporation as herein proposed, is technically qualified to design and construct the proposed facility;

"Issue (4) The applicant is financially qualified to engage in the proposed activities; and

"Issue (5) Construction of the reactor will not be inimical to the common defense and security or to the health and safety of the public."

APPENDIX C

Analysis of Respondents' List of Alleged Reactor Accidents, Prepared by AEC Division of Licensing and Regulation

I. REACTORS IN THE UNITED STATES

A. *Accidents Causing Death or Observed Injury to Operating Personnel*

1. *Reactor:* SL–1, National Reactor Testing Station, Arco, Idaho, boiling water reactor, used for power production, prototype for low-power plant at a remote site.

Date: January 3, 1961.

Nature of Incident: Reactor excursion occurred during shutdown for maintenance. Control rods were disconnected from drives and nuclear instrumentation was not in use. Some of the control rods were ejected from the core.

Radiation level: Over 1000 r/hr. in the reactor building.

*Injuries:** 3 fatalities, the operating personnel in the reactor building.

Evaluation: Evaluation of this accident is still in progress. It appears that maintenance procedures were partially at fault and that the reactivity condition of the reactor was not adequately known or understood at the time of the incident. Although the reactor was not housed in a containment building, offsite contamination was low, despite the very extensive contamination inside the reactor building. No significant radioactive material was released beyond the reactor area.

* "Injuries" in this analysis refers to clinically observed or reported injuries.

B. *Accidents Causing Radiation Overexposure to Operating Personnel Without Observed Injury*

2. *Reactor:* General Electric Test Reactor (GETR); Pleasanton, California, pressurized water reactor, used for materials testing.

Date: March 10, 1960.

Nature of Incident: A technician preparing a GETR fuel element for transfer from the storage pool to the Materials Laboratory inhaled tracer amounts of radioiodine.

Radiation level: 48 rads to the thyroid. (Other employees received doses to the thyroid of from 1.8 to 7 rem).

Injuries: None.

Evaluation: This was not a reactor accident. Its connection with the GETR consists only in that the fuel element from which the iodine was released had previously been used in the reactor. There were no perceptible injurious consequences. Such consequences can be caused only by radiation exposure to the thyroid many times greater than these.

3. *Reactor:* Materials Testing Reactor (MTR), National Reactor Testing Station, Arco, Idaho, water-cooled and -moderated reactor with highly enriched plate fuel, used for materials irradiation and testing purposes.

Date: July 23, 1956.

Nature of Incident: Eight men were working on the top of the reactor near the reactor tank opening (which was uncovered), the reactor being shut down for refueling and maintenance. The water level in the reactor tank was lowered during the shutdown period to facilitate insertion and removal of experiments in the reactor. The men were exposed when a radioactive reactor component was placed in a posi-

tion where it was not adequately shielded because of the lowered water level.

Radiation Level: External doses at top of reactor were as follows: 21 r, 6.2 r, 3.9 r, 6.1 r, 10.6 r, 2.9 r, 2.6 r, and 2.5 r.

Injuries: The men were placed under routine medical observation, but no illness or other radiation-induced effects were observed.

Evaluation: This incident was caused by inadequate radiation monitoring and questionable maintenance procedures. No radioactive material was released from the reactor, and the reactor was not affected by the incident. No effect on persons other than those whose action was responsible for the unsafe radiation condition were affected or could have been affected. Full-time radiation monitoring service has since been provided at the reactor tank opening to prevent any such future exposures.

4. *Reactor:* Chicago Pile, Argonne National Laboratory, Illinois.

Date: June 1952.

Nature of Incident: Manual withdrawal of a control rod from a reactor caused an accidental supercriticality. When the control rod was released, the reactor was shut down.

Radiation Levels: Personnel exposures for the four persons standing on or near the reactor were 190 rem, 160 rem, 70 rem, and 12 rem.

Injuries: The four persons exposed were hospitalized for observation and no injuries or symptoms of radiation illness were noted.

Evaluation: This reactor is an experimental facility at a National Laboratory, and has a considerable de-

gree of flexibility. The above accident was caused by the operators' failure to drain the reactor of water before the control rod was withdrawn. Criticality in the drained reactor would have been impossible. Included in the protective measures taken after the accident was the absolute prevention of access to the room when the reactor was not drained of water.

C. *Other Accidents and Operating Difficulties*

5. *Reactor:* Dresden Nuclear Power Station (Commonwealth Edison Co.), Dresden, Illinois, boiling water reactor, used for power production as central station.

Date: November 15, 1960.

Nature of Incident: One of the 80 control rods failed to follow its drive mechanism upon a rod withdrawal, rod was then driven into core and locked in place. Subsequent examination, after shutdown of reactor, revealed that index tube in drive had fractured, and disclosed surface cracks in some drive components made of 17–PH steel.

Radiation level: None.

Injuries: None.

Evaluation: The situation resulted from stress corrosion of the steel used in the shaft of the drive mechanism. No accident occurred and no hazard existed. All other drive mechanisms performed satisfactorily and appropriate precautions were taken with the failed drive. The drive mechanisms have been modified, by use of different materials, different heat treatment and fabrication controls, to reduce suscep-

tibility to stress corrosion and eliminate further operational difficulties.

6. *Reactor:* Westinghouse Test Reactor (WTR), Waltz Mill, Pennsylvania, pressurized water reactor, used for high-flux materials irradiation.

Date: April 3, 1960.

Nature of Incident: Fuel element had a small (about one-half square inch) area in which bond between fuel and clad was defective. A hot spot developed, the fuel swelled and led to coolant flow restriction and subsequent fuel element failure.

Radiation level: 4–6 r per hr. in the reactor head tank. No one was exposed to this, however.

Injuries: None. No exposures to employees or others above permissible limits.

Evaluation: Although this incident was a serious nuisance and produced large quantities of low-level waste, no hazard was involved. The reactor system was designed in anticipation of possible fuel element failure (the normal practice in high-power reactor design) and no significant activity escaped the facility. Remedial actions include more careful inspection of the fuel elements before their insertion into the reactor and the installation of additional waste holdup tankage and a larger waste evaporator to facilitate cleanup after any future incidents of this type.

7. *Reactor:* Homogeneous Reactor Experiment No. 2 (HRE–2), Oak Ridge National Laboratory, Oak Ridge, Tennessee; aqueous homogeneous reactor used for experimental and developmental purposes.

Date: February 1960.

Nature of Incident: Corrosion of the barrier between the core and blanket regions caused an additional hole in this barrier. A similar hole which occurred about two years previously had not been repaired, and since that time, the reactor had been

operating with fuel solution in both the core and the blanket regions. Thus no substantial change in the condition of the reactor was produced by this new leak.

Radiation Level: None.

Injuries: None.

Evaluation: This was not an accident. One of the principal purposes of the facility is the testing of compatibility of materials, and leaks such as this are not considered incidents or even unexpected events, but rather constitute experimental results. No radioactive material was released when this second hole was produced.

8. *Reactor:* Sodium Reactor Experiment (SRE), Santa Susana, California, sodium-cooled, graphite-moderated reactor used for experimental and developmental purposes.

Date: July 24, 1959.

Nature of Incident: Decomposition products of organic impurities in the coolant caused overheating and melting of fuel. The core was extensively damaged but no significant amount of radioactive material was released.

Radiation Level: None.

Injuries: None.

Evaluation: One of the primary purposes of this facility is the investigation of the compatibility of materials for use in such a facility, and an incident such as this is not totally unanticipated. There are appropriate safety procedures and no hazard resulted.

9. *Reactor:* Situation referred to under "ANP" actually occurred in Heat Transfer Reactor Experiment No. 3 (HTRE-3) at National Reactor Testing Station, Arco, Idaho, gas-cooled, solid-moderated reactor, used for experimental purposes for aircraft propulsion program.

Date: November 18, 1958.

Nature of Incident: Radioactive material was released from the reactor.

Radiation Level: .03 per cent of the site was contaminated. No persons were exposed and no evacuation of personnel was necessary, since facility operations are carried out remotely from a shielded bunker.

Injuries: None.

Evaluation: This reactor is an experimental facility designed and located so that in experimental testing of a nuclear propulsion plant, releases of radioactive material to the atmosphere may be permitted to occur safely. Thus, no hazard to operating personnel or to others existed as a consequence of this release.

10. *Reactor:* Homogeneous Reactor Experiment No. 2 (HRE-2), Oak Ridge National Laboratory, Oak Ridge, Tennessee, aqueous homogeneous reactor, used for experimental and developmental purposes.

Date: April 4, 1958.

Nature of Incident: Corrosion of the barrier between core and blanket regions of the reactor produced a hole in this barrier. Liquid fuel thus filled the blanket region in addition to the core. No fuel or radioactive material escaped from the reactor, and operation was continued with fuel in both regions.

Radiation Level: None.

Injuries: None.

Evaluation: This was not an accident. One of the principal purposes of this facility is the testing of materials compatibility and leaks such as this are not unexpected, and constitute useful experimental results. (See Item 7.)

11. *Reactor:* Godiva, Los Alamos Scientific Laboratory, New Mexico; bare, fast critical assembly, used for basic fast reactor studies.

Date: February 12, 1957.

Nature of Incident: A remotely operated fissionable material assembly produced a neutron excursion greater than intended, resulting in damage to the assembly. Total energy of the excursion was 1.2 x 10^{17} fissions or about one kilowatt hour.

Radiation Level: None, at the point of nearest approach to the facility (about one-quarter of a mile from the assembly).

Injuries: None.

Evaluation: This facility is an experiment operated for the purpose of intentionally producing neutron bursts and is constructed and operated in a manner much different than a normal reactor plant. It is unshielded. Because of the experimental nature of the facility, all persons are excluded from its vicinity and it is remotely controlled from a safe distance, one-quarter mile away. Although the particular neutron burst cited here was larger than was intended, and was severe enough to violently disassemble the system and shut down the assembly, no hazard to any persons existed.

12. *Reactor:* Kinetic Experiment on Water Boilers (KEWB), Santa Susana, California; aqueous homogeneous reactor (water boiler), used for burst experiments in aqueous homogeneous reactors.

Date: January 4, 1957.

Nature of Incident: A small quantity of volatile radioactive material was released into the reactor room by leakage from around a valve stem when the valve was operated. This resulted from failure of a vacuum pump which normally maintained a negative pressure on the gas sampling line in which the valve was located. The building was evacuated until activity levels returned to normal background (less than one day).

Radiation Level: Above normally-accepted levels for continuous indefinite breathing. Building was vacated in about 10 seconds, and no dose of any significance was received by personnel. (No detectable external dose, internal dose less than 50 mr, no activity detectable by urinalysis.)

Injuries: None.

Evaluation: The equipment that failed was a part of the auxiliary plumbing system and not an integral part of the reactor system. Required cleanup effort was comparable to that which might be required routinely in a radioisotope laboratory. As already noted, monitoring procedures adequately detected the contamination and evacuation was completed without difficulty, so that there was no hazard to personnel or others.

13. *Reactor:* Homogeneous Reactor Experiment No. (HRE–2), Oak Ridge National Laboratory, Oak Ridge, Tennessee; aqeous homogeneous reactor, used for development and experimental purposes.

Date: November 1956.

Nature of Incident: Microscopic cracking caused by stress corrosion was discovered in the helium leak detector system and in some of the flanges to which the system's tubing is connected. The condition was discovered during preliminary non-nuclear checkout tests of the plant.

Radiation Level: None.

Injuries: None.

Evaluation: This was not a reactor incident. No nuclear materials were involved in the plant, which had not yet been fueled for operation. Corrosion was caused by chloride ion contamination of the stainless steel leak-detection tubing, as a result of inadequate cleaning and inspection of this auxiliary system tubing. (Extreme care had been taken to exclude all

chlorides from the components of the reactor system itself, but less care was apparently exercised with respect to the auxiliary tubing.) This defect was discovered during non-nuclear checkout of the system "plumbing." The purpose of such checkout is to disclose any such system defects before nuclear fuel is installed in the plant. The discovery of the stress corrosion condition caused a delay of many months in the startup of the HRE–2, but no safety problems were involved.

14. *Reactor:* Seawolf Submarine (S2G), intermediate, sodium-cooled reactor, used for naval propulsion, experimental.

Date: September 6, 1956.

Nature of Incident: Several leaks were detected in superheater and steam generator tubes over a period of time. These tubes are of double-walled construction with a barrier of non-radioactive NaK in the annulus between the walls, and proved very difficult to maintain 100% leaktight.

Radiation Level: None.

Injuries: None.

Evaluation: Materials problems such as this are not uncommon in experimental and development systems. Leaks had developed in the land-based prototype for the reactor (S1G), and their occurrence in the actual ship reactor was not totally unexpected. In order to stop the leaks, it was necessary to block off the affected tubes, resulting in a decrease in the maximum power and speed attainable by the ship. Since the leaks were internal and steam contamination was protected against by means of the intermediate NaK barrier, no question of radiation or radioactive material was involved. The incident was a significant operational nuisance and development problem, but no safety problem was presented.

15. *Reactor:* Experimental Breeder Reactor No. 1 (EBR–1), National Reactor Testing Station, Arco Idaho, fast breeder, sodium cooled reactor, used for experimental fast reactor studies.

Date: November 29, 1955.

Nature of Incident: While the reactor was undergoing a series of scheduled experiments, rapid power surges were intentionally introduced and fuel temperatures were intentionally forced above their normal limits. Automatic protective instrumentation and shutdown devices were disconnected in order to permit the power surge tests without automatic shutdown. During the last test of the series, the reactor overheated rapidly and extensive fuel melting occurred before the operator could initiate manual shutdown.

Radiation Level: None.

Injuries: None.

Evaluation: The EBR–1 is an experimental reactor located in a remote site in order that it can be operated under extreme conditions and in an abnormal manner without producing a safety hazard. When the meltdown occurred, the tests being performed involved the introduction of deliberate and severe abnormalities, with normal automatic protective equipment disconnected, and the possibility of damage to the reactor under such conditions was clearly realized. The damage which did occur was thus more an experimental result than a reactor incident, and resulted in no adverse consequences from the safety standpoint.

16. *Reactor:* One of the Hanford Production Reactors, Hanford, Washington, graphite moderated, water cooled reactor, used for plutonium production.

Date: November 1, 1955.

Nature of Incident: A ruptured fuel slug was forcibly loosed and then flushed from its tube by a high pressure water stream. A flash of flame occurred as the slug came out of the tube at the rear of the reactor. The back of the reactor required decontamination. Some of the surrounding area on the site was slightly contaminated.

Radiation Level: Unknown (low in occupied locations).

Injuries: None.

Evaluation: The incident necessitated a decontamination effort, but there was no actual or potential effect on operation of the reactor, and no potential propagation of the fuel slug failure to other tubes of the reactor. Fuel slug failures are provided for in the design of the reactor and plant equipment. Monitoring instrumentation is in continuous use for the detection of plugging or reduction of coolant flow in the reactor tubes, and equipment is available for removal of failed fuel slugs from the tubes without hazard to plant personnel or others. The plant is so located that the release of fission products associated with fuel failures such as this do not constitute an offsite contamination problem or hazard.

17. *Reactor:* Raleigh Research Reactor (North Carolina State College), Raleigh, N.C., aqueous homogeneous (water boiler) reactor, used for University research and training.

Date: May 1955.

Nature of Incident: The stainless steel core of the reactor developed a leak, allowing fuel solution to leak into the surrounding chamber and into the cooling water.

Radiation Level: None.

Injuries: None.

Evaluation: This failure is typical of the materials problems that have been associated with this and other solution-type reactors. Reactors of this type are designed so that a core tank leak will not permit fuel solution containing radioactive material to escape from the reactor system, thus protecting against hazard if leaks such as this do occur.

18. *Reactor:* Materials Testing Reactor (MTR), National Reactor Testing Station, Arco, Idaho; water moderated and cooled reactor with highly enriched plate fuel, used for materials irradiation and testing purposes.

Date: June 1954.

Nature of Incident: Bulging of some fuel plates was discovered. This caused contact between plates and overheating in a few localized spots. Some fission products were released to the coolant.

Radiation Levels: Up to 3 r/hr on contact at some points in the cooling system.

Injuries: None.

Evaluation: The increased radiation levels of the cooling system caused some short-term operating problems, because the allowable working time for maintenance of the cooling system was reduced. During normal operation, the system is well shielded and no problem was produced by the incident. Once the source of activity had been removed, maintenance time limitations were able to be relaxed. Fuel elements were modified to prevent a recurrence of this incident. No hazard to operating personnel or others existed as a result of this incident.

19. *Reactor:* Godiva, Los Alamos Scientific Laboratory, New Mexico, bare, fast, critical assembly, used for basic fast reactor studies.

Date: February 3, 1954.

Nature of Incident: The reactor was made excess-

sively supercritical during a study of the properties of supercritical bursts. This study involved above-normal burst magnitudes. An error in preparation for the experiment caused this particular burst to be greater than expected, by about a factor of three. The total energy generated in the burst was approximately one-half of one kilowatt-hour (6×10^{20} fissions).

Radiation Levels: None, at the point of nearest approach to the facility.

Injuries: None.

Evaluation: As indicated in item 11, this experimental facility is operated remotely to assure safety of personnel under normal conditions and also under the abnormal conditions of an accident. The only adverse effect of the experiment was damage to the assembly, to the extent of $600, and time lost in repair of the assembly before the next burst.

20. *Reactor:* Clementine, Los Alamos Scientific Laboratory, New Mexico, plutonium-fueled, fast, mercury-cooled reactor, used for basic fast reactor studies.

Date: Prior to dismantling of reactor in December 1957.

Nature of Incident: One of the fuel elements failed, releasing plutonium into the mercury coolant. Since the research and development studies upon the reactor had been completed, it was shut down and later dismantled.

Radiation Levels: None known. This failure is not of a type which would be expected to release a significant amount of radioactive material.

Injuries: None.

Evaluation: This was not a reactor accident. The facility was of a very early fast reactor design and was constructed for developmental purposes. Materials failures of this type cited here are not unexpected or unprepared for in such facilities. Since the re-

actor's planned objectives had been fulfilled at the time of the failure, it was decided not to clean up the coolant and resume operation, but to dismantle the reactor.

21. *Reactor:* One of the reactors at Los Alamos Scientific Laboratory, New Mexico.

Date: December 1949.

Nature of Incident: Supercriticality occurred in the reactor, caused by manual testing of control rod mechanisms.

Radiation Level: One employee was exposed to 2.5r (not above permissible level in effect at that time).

Injuries: None.

Evaluation: The incident occurred in an experimental facility at a remote site. It was caused by manual control rod testing. Such testing is characteristic only of the early stage of reactor development at the time of the incident (1949) and is not practiced today.

22. *Reactor:* X–10 Reactor, Oak Ridge National Laboratory, Oak Ridge, Tennessee, graphite moderated, air cooled reactor used for research and isotope production.

Date: 1947–1948.

Nature of Incident: Fuel elements of the type in use during this period experienced failures at a low rate. On two occasions, one in 1947 and one in 1948, such failure went undetected until the fuel element jacket had swelled enough to restrict cooling air flow in one channel. This caused overheating and failure of other elements in the channel. In each instance, the channel was damaged in removal of the elements and its further use was abandoned. There are 1248 channels in the reactor of which 821 are fueled.

Radiation Levels: None.

Injuries: None.

Evaluation: From the standpoint of hazard, this was not a reactor accident. The reactor operates at a low power level and contains many thousands of fuel elements, so that the quantity of fission products contained in each element is very small. Furthermore, the restriction of air flow caused in an incident such as this serves to block the normal path of release of any radioactive material which might escape from a failed fuel element. While the incident affected operating efficiency, there was no danger to any employee or member of the public.

II. REACTORS IN FOREIGN COUNTRIES*

A. *Accidents Causing Death or Observed Injury to Operating Personnel*

23. *Reactor:* Critical assembly at the Boris-Kidrich Institute, Yugoslavia; natural uranium, heavy water moderated, critical assembly, used for research purposes.

Date: October 18, 1958.

Nature of Incident. Accidental criticality caused by uncontrolled pumping of heavy water into the unshielded tank of the critical assembly.

Radiation Level: The average exposure to personnel located at distances varying from 10 ft. to 25 ft. from the reactor is reported to have been 49 rems of thermal neutrons, 223 rems of epithermal neutrons, 116 rems of fast neutrons, and 295 rems of gamma radiation.

Injuries: One person died as a result of overexposure. Five persons received severe overdoses of radiation but have been reported recovering after receiving medical treatment.

Evaluation: The facility was a zero-power critical assembly, used for research. It was unshielded and

*The analysis of foreign incidents listed by respondents is based solely upon published reports and statements.

the procedure for starting up was to pump the moderator, heavy water, into the reactor tank. This is a major operation and should have been properly scheduled and properly controlled. The severe accident reported came about because (1) there was a failure to control and schedule the pumping, which should not have been undertaken with persons near the unshielded assembly; (2) the monitoring, scram and other safety systems had been turned off.

B. *Accidents Causing Radiation Overexposure to Operating Personnel Without Observed Injury*

24. *Reactor:* NRU, Chalk River, Canada, natural uranium reactor, heavy water moderated and cooled, used for plutonium production, research and materials testing.

Date: May 23, 1958.

Nature of Incident: The incident which triggered the chain of events leading to more serious difficulties was in itself minor. The reactor went through an automatic shutdown initiated by an excessive rise-of-power. This rise-of-power may have been caused by a phenomenon known as water logging of failed fuel elements. It was decided to remove three damaged fuel elements. During this phase of operations, one of the three damaged fuel elements jammed after being raised part way into the carrier flask and was without cooling for 10 minutes. The resulting overheating and oxidation caused a 3 ft. long piece to fall out of the carrier flask when it was being moved over towards the storage area, and to burn in the open air of the reactor room before being extinguished with wet sand.

Radiation Level: Reported radiation in the reactor room after the first incident was 100–1000 mr/hr. However, after the second incident, the radiation fields were probably in excess of 1000 r/hr.

Injuries: Eighteen employees were exposed to radiation as a result of this incident. Of those exposed during the incident, none received exposure higher than 5.3 roentgens. During the cleanup and removal of debris, the highest exposure received was about 6 roentgens. None of these 18 individuals showed any evidence of injury.

Evaluation: The initial incident was a minor one. Contamination of the reactor room and exposure of personnel resulted from the attempt to move the highly radioactive damaged fuel element without assuring that the transfer operations could be performed properly.

25. *Reactor:* Windscale #1, Windscale, England, natural uranium, graphite moderated, air cooled reactor, used for plutonium purposes.

Date: October 10, 1957.

Nature of Incident: During a special annealing operation (Wigner release) of the graphite pile, there was a failure of fuel cladding, which led to exposure of the uranium fuel, oxidation and then to fire in the combustible mass of graphite and uranium metal. Radioactivity was released out the stack (through a filter), dispersed to the atmosphere and caused contamination in the vicinity.

Radiation Level: Not given.

Injuries: Fourteen workers had exposures over the normal 3.0 r for a 13-week period, the highest exposure being 4.66 r. No injuries reported from such exposures or from nearby contamination.

Evaluation: This incident took place during a special plant operation undertaken to release energy stored in graphite by effects of irradiation. This phenomenon of a graphite pile, and the necessity for such operation, was discovered earlier (see item 41). It was reported that this incident occurred because

the operator failed to take sufficient time to perform the Wigner release and there were inadequacies in the operator's training and the written procedures. This reactor is cooled by blowing air through the pile consisting of fuel elements and graphite slabs and exhausting the air out of the stack. Hence, this reactor type does not exhibit the gas-tight plant containment usually associated with power reactor installations. As a result, the radioactive material was released to the atmosphere. The incident necessitated extensive repair and decontamination. However, there were no excessive exposures to radiation and no injurious consequences detected or reported.

C. *Other Accidents and Operating Difficulties*

26. *Reactor:* G–2, Marcoule, France, natural uranium reactor, graphite moderated, CO_2 cooled, used for plutonium production.

Date: July 6, 1960.

Nature of Incident: There was a mechanical rupture of a joint between the loading mechanism and a fuel canal. As a result, a small quantity of CO_2 gas under operating pressure of 220 psi escaped into the reactor hall.

Radiation Level: Not reported. It was stated by a spokesman for Le Commissariat à l'Energie Atomique that the escaping gases were only slightly radioactive.

Injuries: None reported.

Evaluation: Mechanical failure of a component led to escape of small amount of radioactivity into the reactor hall, which was immediately detected by the monitoring instrumentation. The reactor was shut down, pressure reduced to stop the leak and appropriate maintenance work undertaken. No hazard to health and safety of operating personnel was presented.

27. *Reactor:* Research Reactor, Berlin, Germany, aqueous homogeneous reactor, light water moderated and cooled, used for research purposes.

Date: March 1960.

Nature of Incident: A welded metal piece came loose inside the catalyst chamber and impeded the flow of gas.

Radiation Level: None. There was no escape of radioactivity outside the reactor.

Injuries: None reported.

Evaluation: Water decomposes under radiation to hydrogen and oxygen, and this reactor was equipped with a loop through which these non-radioactive gases were drawn, introduced into a catalyst chamber and returned to the reactor vessel as water. The failure of a component of that chamber did not present any safety problem.

28. *Reactor:* Japanese Research Reactor #1, Tokai Mura, aqueous homogeneous reactor, light water moderated and cooled, used for research purposes.

Date: December 8, 1959.

Nature of Incident: Officials at the reactor plant stated that a minor incident occurred which resulted in radioactive contamination of the reactor section, and that the radioactivity was completely contained in the reactor section. Insufficient information is available to us to give further details or permit of any evaluation.

29. *Reactor:* AGN-211, Basel, Switzerland, solid homogeneous reactor, polyethylene moderated, light water cooled, used for research purposes.

Date: November 10, 1959.

Nature of Incident: Failure of the polyethylene matrix around the fuel.

Radiation Level: Radioactivity level of the reactor water increased to a maximum of 3×10^{-4} microcuries

per cm³ after 1½ hrs. of operation at 100 watts. No increase in radiation in areas accessible to individuals.

Injuries: No overexposure or injuries reported.

Evaluation: In this small research reactor, the fuel is dispersed as grains in a polyethylene matrix immersed in the reactor water. Due to a failure of the bonding between some of the fuel grains and the matrix, small quantities of gas escaped into the reactor water. The leak stopped upon reduction of power to 50 watts. This difficulty had no adverse consequences for the health and safety of personnel.

30. *Reactor:* EL–2, Saclay, France, natural uranium, heavy water moderated, CO_2 cooled reactor, used for research and isotope production.

Date: February 16, 1959.

Nature of Incident: Overheating of fuel element resulted in rupture of cladding and the escape of radioactivity into the CO_2 stream.

Radiation Level: It is reported that there was no trace of radioactive contamination outside the reactor into the reactor room proper.

Injuries: No overexposure or injuries reported.

Evaluation: A breach in the integrity of the cladding in a fuel element caused escape of fission products into the coolant, a minor operating difficulty. The monitoring system is equipped to detect such escape. In each of such reported incidents at Saclay, the difficulty was immediately detected. Thereafter, the reactor was shut down and appropriate maintenance work done to locate and replace any defective fuel element, and clean up the coolant gas where necessary. In some cases the repair work was apparently time-consuming and expensive. However, there was no threat to the health and safety of the operating personnel at any time.

? .. *Reactor:* EL–2, Saclay, France, natural uranium, heavy water moderated, CO_2 cooled reactor, used for research and isotope production.

Date: December 27, 1958.

Nature of Incident: Failure of the cladding of a fuel element resulting in escape of radioactivity into the CO_2 stream.

Radiation Level: Certain components in the closed CO_2 system indicated 4 times the maximum permissible level.

Injuries: No overexposure or injuries reported.

Evaluation: Same as in item 30.

32. *Reactor:* Calder Hall, Calder Hall, England, natural uranium reactor, graphite moderated, CO_2 cooled, used for power production.

Date: June 28, 1958.

Nature of Incident: There was a mechanical failure of a steam turbine.

Radiation Level: None.

Injuries: None.

Evaluation: The failure of the steam turbine led to a shutdown of the reactor, since the latter was producing steam for the turbine. The incident, however, was a mechanical failure in the turbine which had nothing to do with the nuclear installations of the plant.

33. *Reactor:* EL–3, Saclay, France, slightly enriched uranium reactor, heavy water cooled and moderated, used for research and materials testing.

Date: April 13, 1958.

Nature of Incident: Aluminum channel in which a fuel element was situated broke and fell as result of vibration and lack of support. This interrupted the forced circulation cooling of the fuel element, and led to overheating and rupture of the fuel element.

Radiation Level: No contamination of the reactor room, established by analysis of the air as well as a check of the personnel. Any radioactivity which escaped from the fuel slug was confined to the primary coolant and the closed helium gas systems.

Injuries: No overexposure or injuries reported.

Evaluation: The release of radioactivity into the coolant by this mechanical failure of a component was promptly detected. The situation is similar to that evaluated in item 30.

34. *Reactor:* SAPHIR, Würenlingen, Switzerland, pool type reactor, 20% enriched uranium, light water cooled and moderated, used for research purposes.

Nature of Incident: No incident of any kind is reported at the reference given in respondents' brief.

35. *Reactor:* EL–2, Saclay, France, natural uranium, heavy water moderated, CO_2 cooled reactor, used for research and isotope production.

Date: November 26, 1957.

Nature of Incident: Overheating of an aluminum clad uranium slug because of insufficient cooling water flow, hole in cladding released radioactivity into cooling water.

Radiation Level: No increase of the radiation level in the reactor hall reported.

Injuries: No overexposure or injuries reported.

Evaluation: Same as item 30.

36. *Reactor:* G–1, Marcoule, France, natural uranium, graphite moderated, air-cooled reactor, used for power production demonstration and plutonium production.

Date: October 26, 1956.

Nature of Incident: The failure of the canning exposed an uranium slug with subsequent oxidation and dispersion of fission products into the reactor's cooling air.

Radiation Level: It was reported that the maximum concentration of radioactive material in the air was 5 x 10^{-8} microcuries/cm^3 for a few minutes at the base of the stack. It is noted, however that the measurements of the activity in the air by the stations outside the site always remained well under the maximum permissible limit.

Injuries: It was reported that personnel were not exposed to radiation above permissible limits and no injurious consequences were noted.

Evaluation: The failure of fuel canning released a small quantity of radioactive fission products into the coolant. This was promptly detected by monitoring instrumentation. The reactor was shut down and appropriate action taken. The report stated that a minor accident of this order is not dangerous either for the personnel or for the reactor.

37. *Reactor:* J E E P, Kjeller, Norway, natural uranium, heavy water moderated and cooled reactor, used for research purposes.

Date: February, 1954.

Nature of Incident: The incident occurred in a channel of the reactor used for irradiation purposes. The aluminum canning in an irradiation channel failed, exposing an uranium slug, with subsequent oxidation.

Radiation Level: Not given, but required evacuation of reactor hall. The report stated that radioactive dust spread into the reactor hall when the irradiation channel was opened, personnel were evacuated and had to don protective clothing and masks before reentering the building.

Injuries: No overexposure or injuries reported.

Evaluation: This incident did not involve the reactor fuel elements or any defect in the operation of the reactor itself. The failure occurred in a can

placed in the reactor to be irradiated for experimental purposes. It was apparently due to careless experimental procedures, and necessitated appropriate maintenance and decontamination.

38. *Reactor:* Windscale #1, Windscale, England, natural uranium, graphite moderated, air cooled reactor, used for plutonium production.

Nature of Incident: No incident is reported in the reference given in respondents' brief.

39. *Reactor:* Russian heavy water research reactor (HWRR), slightly enriched uranium reactor, heavy water moderated and cooled, used for research purposes.

Date: 1953.

Nature of Incident: Failure of the cladding of an uranium rod, releasing radioactivity into the reactor vessel.

Radiation Level: The presence of fission products in the reactor's helium blanket was reported.

Injuries: No overexposure or injuries reported.

Evaluation: As reported, the initial incident was a failure of fuel cladding, a minor difficulty which was detected and which led to appropriate routine measures to replace the fuel element. The subsequent falling of the element and damage to the reactor tank, necessitated a difficult repair job. However, such repairs can be done safely and no injury or overexposure is reported.

40. *Reactor:* NRX, Chalk River, Canada, natural uranium, heavy water moderated, light water cooled reactor, used for research purposes.

Date: December 13, 1952.

Nature of Incident: During an experiment, a power surge occurred because of mechanical failure of the safety shutdown system, resulting in melting of part of the fuel rods.

Radiation Level: Not given. Plant personnel were required to evacuate the site.

Injuries: No overexposure or other type of injuries reported. At times during the repair work it became necessary to allow individuals to take a thirteen-week dosage (3.9 roentgen) in a matter of a day or two and subsequently bar them from the radioactive area for a period of 13 weeks.

Evaluation: This accident took place during a period of experimental work with the reactor and was probably associated with special experimental conditions. It was a serious accident in terms of the extensive repair and decontamination work required in the reactor building and the reactor vessel. No adverse health and safety consequences were noted to operating personnel and there was no danger to the public.

41. *Reactor:* Windscale #1, Windscale, England, natural uranium, graphite moderated, air cooled reactor, used for plutonium production.

Date: September 1952.

Nature of Incident: Unexpected release of energy accumulated in the graphite blocks, manifested as an increase in the temperature of the graphite pile.

Radiation Level: Not reported.

Injuries. No overexposure or injuries reported.

Evaluation: This was an unexpected minor occurrence which did not result in any officially reported or otherwise known consequences to the health and safety of the personnel or the public. It alerted the plant management to the "Wigner effect," the accumulation of energy in graphite subject to irradiation, and led to the development of procedures or periodic deliberate releases of Wigner energy. See item 25.

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In The

Supreme Court of the United States

October Term, 1960

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United States of America and Atomic Energy Commission, *Petitioners*,

v.

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On Writs of Certiorari to the United States Court of Appeals For the District of Columbia Circuit

BRIEF OF ADOLPH J. ACKERMAN, AMICUS CURIAE

ADOLPH J. ACKERMAN
Consulting Engineer
1250 Sherman Avenue
Madison 3, Wisconsin

Of Counsel:

R. M. STROUD
1 West Main Street
Madison 3, Wisconsin

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BRIEF OF ADOLPH J. ACKERMAN, AMICUS CURIAE

STATEMENT OF POSITION

This brief is respectfully submitted to the Supreme Court of the United States by Adolph J. Ackerman, *amicus curiae*, an American citizen residing in the City of Madison, Wisconsin. He is engaged in the practice of professional engineering in the field of electric power and water resources development. This includes the economic appraisal of proposed programs of development and the general planning and site selection for new power plants. He received a Bachelor of Science degree in electrical enginering from the University of Wisconsin in 1926 and a degree of Civil Engineer from the same University in 1935. The State of Wisconsin granted him a license to practice engineering in 1953, and he is also licensed to practice in various other States; he began his formal professional practice in 1937 under a license granted by the State of Tennessee. Part of his time is devoted to the educational field in professional engineering as a Visiting Professor and as a member of a Visiting Committee at two leading universities. He has also served on various committees of National Engineering Societies which have been concerned with the practical application of atomic energy.

REASONS PROMPTING THE SUBMISSION OF AMICUS CURIAE BRIEF

The issues before the Court in this proceeding are of grave importance in the application of the new science of atomic energy for the generation of electricity, and involve heavy responsibilities concerning the health and safety of the general public. Beyond the questions which have been defined in terms of embryonic law and emerging regulatory principles, is the fundamental question whether a potential hazard of unprecedented magnitude shall be introduced in an area where a large population would be exposed to it. The Court's decision in this case is bound to have direct and far-reaching influence on the progress and application of atomic power and on the related questions of public health and safety.

The selection of a site for an atomic power plant is not governed by rules of law, but calls for the application of expert judgment by professional engineers. It is a problem involving great responsibility and technical complexity on which the available knowledge is relatively limited.

Although the criteria for the selection of a site for a *conventional* type of power plant correspond to well established principles based on the operating experiences of many similar power plants in all parts of the country, the introduction of *atomic energy* for the generation of electricity has brought with it new criteria for site selection. It will be shown that some of the criteria employed in the selection of the site for the atomic power plant in the case before this Court violate the traditional principles of responsibility which the engineering profession is expected to

observe. The basic issue, therefore, although it here concerns specific parties, is of deep concern—now and for all future time—to professional engineers.

It is the belief of amicus curiae that an exposition on the responsibilities of the professional engineer in relationship to the tremendous perils involved in the application of a new science will help to clarify the fundamental questions before this Court. This brief, therefore, represents an effort on the part of a professional engineer to meet his obligations in serving the public interest.

Questions Relating to the Project

The questions before this Court relate to an atomic power plant (Enrico Fermi) currently under construction by the petitioner, Power Reactor Development Company (PRDC), at a site known as Lagoona Beach, some 29 miles southwest of the City of Detroit, Michigan. Although a specific project is here involved, the issues are of overriding importance and applicable to all atomic power developments, whether owned privately or by public bodies.

Why is there a conflict? This question is discussed in considerable detail in the present brief, but the following basic factors are elements in the conflict:

1. In the selection of this power plant site, the normal influences of professional engineering responsibility for the protection of the public—and the ethical obligations of the engineering profession—have been denied their normal freedom of action.

2. Once the atomic power plant goes into operation, the surrounding population (although generally unaware

of its position) would be living in the shadow of a potential disaster of unprecedented magnitude. For this reason part of the population in the vicinity is seeking relief from the Court to prevent this project becoming an operating hazard.

3. In the event of a major accident or failure of the atomic energy unit, most of the resulting cost of the disaster would fall on the taxpayers of the country. At present they are generally unaware of this potential new burden.

4. In applying for a license for this new power plant (which was approved by the Atomic Energy Commission) some unusual procedures were introduced.

a. A first license has authorized only the *financing* and *construction* of the power plant, on the strength that this involves no atomic operating hazards; however, the magnitude of such potential hazards was recognized.

b. A second license for the *operation* of the power plant is to be considered some years later, after the large capital investment has been made. This sequence may create an element of pressure for gaining approval from those who must finally pass on questions of safety in the operation of this plant.

QUESTIONS BEFORE THE COURT

1. Does the Atomic Energy Act of 1954 require the Commission to withhold approval of a site for an atomic power reactor near a populous area, unless the Commission finds that there are "compelling reasons" for approving such location?

2. Before granting a permit for the *construction* of a developmental atomic power reactor, is the Commission required, under the Atomic Energy Act of 1954, to determine that the proposed reactor can also be *operated* at a proposed location without undue risk to the health and safety of the public?

SUMMARY OF ARGUMENT

1. The fundamental question is this: In the experimental or commercial application of a new scientific discovery of an extremely dangerous type, is adequate protection being provided for the health and safety of the public?

2. In the normal course of our historical development the health and safety of the public have been safeguarded by two basic influences which have grown up as intrinsic features of our social and economic system and of our Constitutional form of government. The first influence is a broad structure of law which has been enacted at the local, state and national levels of government; this is administered by selected public officials and is upheld by a distinguished profession in law, as well as by an independent judiciary at each of these levels. The second influence is an equally broad structure (at the local, state and national levels) of trained specialists in the professions of medicine and engineering; these carry out their responsibilities within the law, but with the added obligation of observing the self-imposed disciplines and ethical standards of their professions. Both of these influences are the product of centuries of experience in human relations and mutual confidence.

3. The new scientific discovery of atomic energy is of fundamental importance and far-reaching influence throughout the world. However, its complexities are understood by an extremely small number of scientists; furthermore its application in the useful service of man (for the production of electricity) is generally regarded as being only in the experimental stage.

4. The case before the Court raises some basic questions regarding the application of atomic science under a very limited structure of new law and in conflict with the established disciplines and ethical standards of the engineering profession. This is the first case of its kind before this Court concerning the administration of such law and the final decision will have an important bearing on the future trend in the application of this new science.

5. An objective of this brief is to demonstrate that the present issues before the Court have developed out of various current deficiencies in our social and economic system, and out of the abandonment of the normal sense of responsibility in the application of a hazardous new science.

6. The application of atomic science for the production of electricity ("atomic power") has developed under unique circumstances as a result of an historical coincidence. Scientists succeeded in making the first experimental demonstration of nuclear fission in the same year that World War II began. The destructive potentials of nuclear fission were soon recognized, and this led to the rapid development of the atomic bomb. All of this work was done under governmental control and in strictest wartime secrecy. With the end of the war came a strong desire to apply atomic energy to beneficial uses and, as a first step, Congress passed the Atomic Energy Act of 1946. However, this Act established atomic energy as a government monopoly and subjected the research and development work on such applications to full governmental control. Some eight years later new legislation was enacted (in 1954) which relaxed the governmental monopoly features—but did not eliminate them.

7. In general, the development of atomic power has taken place in a direction opposite to that which has occurred in the production of electric power from coal, oil or falling water. These conventional power sources have grown up step by step through a multi-centered process of development, and under exacting standards of design which carry the approval of the engineering profession. Governmental controls have been devised as the need developed. In contrast, the current development of atomic power is taking place in reverse sequence, starting with the status of a government monopoly. This is interfering with the application of the established disciplines and responsibilities of the engineering profession for safeguarding the public health and safety.

8. In the case of the atomic power project before this Court, if the location of the project had been established within the normal disciplines and responsibilities of the engineering profession, the present site could not have been approved. When an Advisory Committee originally reviewed the proposal, it found the available information insufficient to give assurance that the reactor could be operated at this site without public hazard. Unfortunately, the opinion of this Committee did not prevail.

9. The historical development of law at the state and local levels which, in essence, holds individuals and companies responsible for any damage which their activities might inflict on the public, has produced nationwide standards of public safety. As a concurrent influence, the insurance industry has demanded high standards of safety and the application of sound engineering practices as a prerequisite to writing insurance against any liability which

might arise. In the new and startling developments of atomic power the insurance industry was confronted with many new problems and potential hazards of unknown magnitude. Estimates released by the Atomic Energy Commission revealed that property damage from the failure of an atomic power plant could amount to more than $2,000,000,000, that fatalities could number in the thousands, and injuries in the tens of thousands. The insurance industry sought to serve this new area of risk-taking, but found it beyond its capabilities. The various companies finally pooled their resources and agreed to provide up to $60,000,000 in public liability insurance for an atomic power plant. Although this was an unprecedented amount for the American insurance industry, it fell far short of protecting the manufacturers and the agencies which might engage in the production of atomic power.

10. It must be viewed with regret that this problem was resolved by placing on the Federal Government and, thus, on the nation's taxpayers, the liability for any damages (in excess of the amounts covered by the insurance companies) which might result from an atomic power plant disaster. This did not, of course, eliminate the hazard; it only relieved the agencies which might engage in the development or production of atomic power of the great financial responsibilities in the event of a disaster. This is the situation which applies today to all large atomic power projects.

11. The developmental and design programs of the past 15 years, together with operating failures which have occurred on small scale "pilot" atomic power plants, have confirmed the terrifying potentials of disaster which may be associated with such power plants.

12. It is generally recognized that the conventional energy resources of coal, oil and falling water are more than adequate to meet the foreseeable power needs for the remainder of this century. This removes the concept of urgency for generating electricity from "atomic fuels," or of taking chances which involve potentially disastrous consequences (no matter how remote they may be "believed" to be) on the grounds that by so doing the development of atomic power would be "accelerated."

13. The idea that history tends to repeat itself may find some confirmation in the present case. In 1929 the late Lord Chief Justice of England, Hewart of Bury, wrote in eloquent terms about the emergence of a new system of law. He called attention to the trend (in this age of technology) of transferring great responsibilities, by legislation, to new administrative agencies; these, in turn, are given wide range of authority to establish admi strative controls and regulations which eventually become administrative laws." This, he warned, may eventually lead to "administrative lawlessness." Such a trend, obviously, would contain hidden dangers to our Constitutional system of government and to the Rule of Law, as well as to the independence of our established system of justice.

14. The factors and relevant issues involved in the present case are much broader and far-reaching than the simple question whether a specific atomic power reactor should or should not have been constructed at a particular site. The Court's decision in this case could have a far-reaching influence in preventing the abandonment of principle for expediency.

ARGUMENT

I. OBJECTIVE OF THIS BRIEF

The objective of this brief is to demonstrate that:

I. The present issues before the Court have developed out of one or more of the following deficiencies:

(a) Circumvention of the responsibilities of the independent professional engineer;

(b) harmful exploitation of engineering responsibilities;

(c) harmful exploitation of public confidence in the engineering profession;

(d) failure of leaders in the engineering societies to defend the position and responsibilities of the profession;

(e) failure of leaders in higher education and in scientific societies to provide effective interpretation of this new science to public authorities and to the professions;

(f) overzealousness and uncontrolled pressures to manufacture and sell new types of atomic equipment;

(g) undisciplined efforts to excel in new technological achievements;

(h) abandonment of management and corporate responsibilities (as a consequence of special legislation), and transfer of such responsibilities to the Federal Government;

(i) unwillingness or failure on the part of those in high governmental authority to seek or accept responsible engineering advice;

(j) a combination of these deficiencies which may be summarized as "a situation peculiar to these times of declining self-discipline and morality."

II. These deficiencies have led to a situation which is harmful to the public interest and the national welfare. The various areas of responsibility which are involved in the development and practical application of the new science of atomic energy will be reviewed in greater detail.

II. A CONFLICT OF RESPONSIBILITIES

A factor contributing to the present case is the lack of common understanding regarding the basic difference in responsibilities as between scientists and engineers. As a matter of fact, in recent decades there has emerged such a confusing concept of these two professions that the terms "scientist" and "engineer" are at times used interchangeably or in combination as "engineer-scientist." Such a confused use of these designations is harmful to public safety as well as to national policy.

Technology During World War II

World War II was largely a terrifying struggle in the application of modern engineering and science; in the course of this struggle, our nation mobilized its resources of engineering and of science into a single collective "force of technology."

The end of the war left the world disrupted at all levels of civilized endeavor. From this chaos new levels of authority and responsibility had to be established either through the exercise of dictatorial powers or by the slower processes of democracy.

In this historical transition from war to peace the normal areas of responsibility as between the scientist and the engineer have *not* been re-established on a basis which would best serve the national welfare. As a matter of fact, the traditional concepts in such matters have become obscured within both of these great professions, and there is little evidence that their members have the resources or the will to redefine their respective areas of responsibility. This must be regarded as a basic defect in our national posture. Furthermore, it can be shown to be a factor in the conflict which this Court has been asked to resolve.

The Decisive Powers of Modern Science

Modern science has demonstrated that it can open the way to a golden age if it is developed in freedom for the benefit of mankind. However, as some of the basic forces of science are becoming all-powerful, modern science is also providing the means for a "reign of terror" under the threat of "total destruction" if these forces are concentrated in the hands of the few and directed toward selfish or ruthless ends. The history of mankind has been a story of being buffetted by the forces of good and evil. Today, more than ever, the choice of direction for the future of man depends upon the wisdom of great decisions involving the application of scientific principles.

One of the great truths of our technological age has been stated in these words: "Modern science is the blessing and curse of our age; it holds decisive powers for good and for evil." Today the ability of man to govern himself—to control his own destiny—has been seriously challenged.

Professional engineers, working in freedom, have a primary responsibility of making plain to their governments, their fellow citizens, indeed to all mankind, the true nature of this situation and of the awesome choices it presents. In meeting this obligation it is their duty to give overriding consideration to the public safety and to the national welfare. This is a moral responsibility—a moral responsibility for the direction taken by our civilization and for the sort of lives our children's children shall inherit.

Definitions of "Scientist" and "Engineer"

There is as much difference between the roles of the scientist and of the engineer as there is between night and day. Specifically, the scientist makes things known and the engineer makes things work. A world-renowned scientist has identified the fundamental characteristic of a scientist by saying that "the most common activity in which a scientist finds himself is to make mistakes, recognize them and correct them."[1] In other words, out of the repeated failures in a research project the skilled scientist eventually brings forth a new discovery. This is the ultimate objective of a scientist. His training has prepared him to become an expert in experimenting; however, no matter how great the

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[1] "What Is Scientific Education?" Address presented at Marquette University, Milwaukee, Wisconsin, May 20, 1959. Unpublished transcript from Marquette University.

public esteem may become as a result of his discovery, he has not become vested, overnight, with any peculiar authority to decide on its use.

Too many scientists, if they succumb in later years to the temptation of assuming administrative or governmental authority, are prone to experiment also in public affairs and to commit monumental errors.

In contrast, the engineer is trained and disciplined *not* to make mistakes. He commits himself to the severe discipline and moral obligation of applying scientific principles within established rules of public safety and with due regard to economy and the national welfare. Within these severe demands on personal integrity the professional engineer undertakes to synthesize a wide range of technical, legal, financial and social requirements and to function as a planner, designer, builder or administrator. However, it must be remembered that the *application* of scientific discoveries remains the task of fallible men and, once the engineer has made a serious mistake, his professional standing may be damaged or permanently ended.

The engineer's conservatism and sense of responsibility in the practical application of scientific discoveries has, in the past, taxed the patience of many a scientist. If left to his own devices and to his "privilege of making mistakes," the scientist is inclined to adopt "short-cuts" in approaching his objectives, and to by-pass the moderating influence and professional disciplines of the engineer. A statement by a noted scientist regarding the post-war development of atomic energy is an example of this philosophy: "The simultaneous pursuit of programs of research,

development and construction has become standard in the fast-moving field of atomic energy."

In recent decades the distinctive functions and responsibilities of the professional engineer have become so obscured that a detailed exposition is needed here to identify some of the important elements, particularly as they apply to the conflict before this Court.

The Role of the Professional Engineer

The purpose of engineering is to serve mankind; this service is achieved through the individual and personal responsibility of the professional engineer. His professional services demand every bit as much personal attention and responsibility as that of a surgeon performing a highly critical operation.

Although a professional engineer may rise to a high position of success and public recognition for his achievements, there is, unfortunately, a general lack of understanding and appreciation of the great risks and personal responsibilities which he assumes in his work. Too often this part of the engineer's function comes to public attention only in the event of a failure. Numerous failures have occurred in the past, generally with tragic consequences to the engineer.

As an example, a disastrous failure in engineering occurred on the night of March 12, 1928 when the St. Francis Dam in California broke, resulting in 700 houses being swept away and a loss of 450 lives. The Chief Engineer who was responsible for the design and construction of this

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Brief For the Petitioners, United States and Atomic Energy Commission, No. 454, This Term, p. 45.

dam, Mr. William Mulholland, after 40 years of leadership in his profession, declared: "Don't blame anybody else. Whatever fault there was in this job, put it on me. If there were any errors in judgment—and it's human to make mistakes—the error was mine. I envy only those who are dead."[3]

There is no substitute for such a concept of responsibility in engineering. This sense of personal responsibility on the part of each engineer is particularly important in areas of general public service, such as electric power supply or municipal water supply. Adequate protection of the public health and safety calls for a nationwide resource of engineers who are dedicated to the practice of their profession in accordance with established disciplines and ethics. Such engineers have the obligation of building and operating public and private facilities of all types which conform to approved standards of design and economy and which contribute to the advancement of the nation within our Constitutional form of government and within the established rules of law.

It is in these terms that the engineering profession is a vital national asset whose members are skilled in applying scientific discoveries for the benefit and well-being of the public. Unwarranted political influence or encroachment on their responsibilities and authority would clearly be a violation of public trust.

Thaddeus Merriman, the former Chief Engineer of the Board of Water Supply for the City of New York has summarized the professional engineer's obligations as follows:

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[3] **Western Construction News**, Quoted in editorial, San Francisco, California, Volume III, Number 7, p. 223, April 10, 1928.

". . . [The engineer's] duty does not lie only in saving a maximum of his client's money. It demands absolutely that the public be afforded a maximum of safety. If the client is unwilling or unable to pay for that maximum then he should not have [his project]. And what is true in the case of a private client is just as importantly true when the engineer acts for public authority —he must still protect the public—no one else can perform that function."[1]

The sense of responsibility of professional engineers, together with the confidence of the public in the engineering profession, comprise a rich heritage which stands as the primary bulwark for the protection of the public in the application of science and technology. This confidence must be maintained and merited in the future as an essential feature of a free society. The public has a right to expect absolute intellectual honesty. Herbert Hoover has stated most precisely that "technology without intellectual honesty will not work."

The Importance of Freedom in Engineering

It has been well stated that: "Without engineering, freedom could bring you a happier but not an easier life. Without freedom, dictators could use engineering to enslave you."[2]

Without freedom the professional engineer is unable to meet his ethical obligations in the practice of his technical skills, and without freedom, he is unable to serve his client's and the public's interest to best advantage.

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[1] Merriman, Thaddeus. "Naught But the Best." **Civil Engineering**, December 1939. pp. 701-702.

[2] Inscription on Museum of Science and Industry, Chicago, Illinois.

A noted engineer has described the obligations of the professional engineer in these terms:

> "Since engineering is a profession which affects the material basis of everyone's life, there is almost always an unconsulted third party involved in any contract between the engineer and those who employ him, and that is the country, the people as a whole. These, too, are the engineer's clients, albeit involuntarily. Engineering ethics ought, therefore, to safeguard those interests most carefully. Knowing more than the public about the effects his work will have, the engineer ought to consider himself an officer of the court and keep the general interest always in mind.
>
> "Service ceases to be professional if it has in any way been dictated by the client or employer. Professional independence is not a special privilege but rather an inner necessity for the true professional man and a safeguard for his employers and the general public. Without it he negates everything that makes him a professional person and he becomes at best a routine technician or a hired hand, at worst, a hack.'"

In recent years decisions have been made in areas of science—areas in which even the well educated man is often a stranger—which affect the lives and welfare of many people and of entire nations. However, if a free society is to remain free, it must demand the application of scientific discoveries under the dedicated responsibility of professional engineers working in freedom.

Responsibilities and Limitations in Engineering Design

The predominant influences of science and of engineering have appeared on the world's scene within the past cen-

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[1] "The Meaning of Your Profession." 104 Cong. Rec. 18349, 18351.

tury, which, in terms of history, is a relatively short time. The turn of the century marks the beginning of the revolutionary period of modern science, and it is still within the span of our lifetimes that engineers have become a vital factor in the American industrial scene. Not long ago industrial development depended largely upon mechanical inventiveness. With the advent of modern science have come discoveries and explanations which are more fundamental. Yet, such fundamentals do not explain what is engineeringly sound.

With the advent of a new science the engineer cannot minimize or ignore a potential hazard on the grounds that all of the scientific data necessary for a complete understanding of the hazard are not available. In fact, it is precisely in such areas where the professional skills and judgment of the engineer take on added importance as a moderating influence.

Recognizing that error is an inherent factor in all human activity, the professional engineer applies his technical knowledge and professional disciplines preponderantly on the side of safety. One of his most important tools is the "factor of safety." For example, the stability of a dam may have a factor of safety of 2; this means that before such a structure would fail, the supported load would have to be twice the assumed or predictable load for which the structure was designed. Thus the factor of safety compensates for unexpected or unpredictable greater loads in the coming decades, as well as for possible deterioration with time.

The factor of safety has also been called the "factor of ignorance"—as an acknowledgment of the inability to predict all of the events which a structure may experience

in the future. Similar criteria apply in all engineering but, in spite of all the applied skill and precautions, failures continue to occur for many reasons which could not be anticipated in the original design.

There is no such thing as foolproof design or operation of a power plant. The possibility of an accident or disaster is ever present and the biggest disasters have been the most incredible. Generally, out of a painstaking investigation of a disaster a complex chain of "incredible" circumstances has emerged to explain the cause.

Modern history records numerous disasters in engineering and technology, with tragic loss of life, such as the sinking of the "unsinkable" Titanic, the conflagration in the "fireproof" Iroquois Theater, the explosion of gas in the new school of New London, Texas, the collision of two large passenger airplanes over the vast expanse of the Grand Canyon region. Many others could be cited. In every case there was a great loss of life and property. And in every case the odds against the occurrence were undoubtedly considered to be fantastically large. Nonetheless, they did occur and there is no reason to believe that others will not occur in the future.

Separation of Responsibilities of Engineers

The personal responsibilities of a professional engineer are at times so great that it is in the best interest of all concerned to subdivide and isolate the main areas of engineering responsibility, and to adopt a system of checks and balances similar to the system of our republican form of government.

For example, a project may be undertaken by a corporation whose chief engineer has the primary responsibility of interpreting the particular objectives as laid down by his directors. (This would correspond to the legislative branch of our government.)

A second area of responsibility is undertaken by a separate consulting engineer and his firm which create the designs within economic limits and under approved factors of safety; this firm would also supervise the interpretation of its designs during the period of construction and during the manufacture of the required machinery and materials. (This would correspond to the administrative branch of our government.)

A third area of engineering responsibility rests on the shoulders of the chief engineer for the contractor who undertakes the construction of the project for a specific price. His primary obligation is to devise the most efficient and economical construction techniques in full compliance with the plans and specifications. (This would correspond to a second area within the administrative branch of government.)

A fourth area of engineering responsibility is assigned to an independent consulting engineer (or to an independent board of consulting engineers), with the overriding duty of looking after the owner's and the public's best interests, by acting as an observer or technical auditor during the planning, design, financing and construction of the project, and in reviewing issues which may run into conflict. (This would correspond to the judicial branch of the government.)

Such a system of coordinated professional controls, functioning freely, but without compromise on important professional responsibilities in each of the four areas has, in the past, produced notable engineering achievements; more importantly, it has effectively minimized the occurrence of serious mistakes or failures in the administration and execution of the work.

Unfortunately, in recent years this system of control of engineering responsibilities has been displaced all too often by political domination of such controls. In other cases the so-called "more efficient package deal" system of contracting has been offered in which the constructor or even the manufacturer of power plant equipment undertakes to provide all of the services, not only of construction and manufacture of the equipment, but also the engineering planning and design, with the engineers appearing in direct partnership or as sub-contractors. It is inevitable that in such cases the independent professional control of major engineering responsibilities (in the best interest of the client and the public) is obliterated and displaced by the motivations of easier profits for the constructor or the manufacturer. In some cases this has led to very faulty engineering planning and construction, or in other cases to scandalous performances in diverting and wasting public funds even though the design and construction may have been of good quality.

III. UNIQUE HISTORICAL FACTORS IN ATOMIC POWER DEVELOPMENT

The unique circumstances under which atomic power has been developed appear to be largely the result of an historical coincidence. In 1939 experimental demonstration had been made of the phenomenon known as nuclear fission. This same year also saw the outbreak of World War II. When it became evident that this newly discovered phenomenon might be applied to the fabrication of a weapon with unprecedented destructive power, the subject of nuclear fission (atomic energy) became a "top secret" high priority program under strict military control. This program was almost totally concerned with the development of a new type of bomb. Destruction was the primary objective; cost was of secondary concern. The terrifying demonstration of the atomic bomb's power in 1945 removed all doubts regarding the outcome of this wartime project.

With the advent of the fearfully destructive power of the atom has come a universal hope that eventually this power would be harnessed for equally impressive purposes in the service of mankind. Unfortunately, however, this hope has been permitted to grow, through excessive publicity and false propaganda, to a point where the practical realities have become obscured. Once a new scientific concept with revolutionary potentialities has been demonstrated to have a certain "technical feasibility," it is still far removed from economic application.

After the end of World War II the high priority program of atomic energy for military use was modified. This led to the passage of the Atomic Energy Act of 1946 (60 Stat. 755), which established atomic energy as a Govern-

ment monopoly. A basic factor in this decision (as acknowledged by the Congress in the Act itself) was the inability to predict how, or when, atomic energy could be used for civilian purposes. Accordingly, research and development of atomic power reactors for the production of electricity grew up as a monopoly venture under the control of the Atomic Energy Commission.

As in the case of the atomic bomb, the atomic power reactor also employs the principle of nuclear fission but, instead of suddenly releasing an enormous body of heat by explosion, the power reactor[1] is designed to maintain a controlled release of a limited amount of heat over a long period of time. This controlled heat is delivered to a heat exchanger where water is converted to steam; the steam, in turn, drives a conventional turbine generator for the production of electricity.

The appropriation of great sums of federal funds provided a major impetus for the atomic power program. Any question regarding soundness of the program was swept aside by a variety of considerations, including: willingness to accept unsupportable claims regarding the great potentialities in the new science; and desire for prestige by being first among the scientists of the various nations with any new developments.

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[1]The special type of reactor to be employed by PRDC is called a "breeder reactor." The energy source will be fuel rods of enriched uranium. As these are consumed by fission at high temperature for the production of steam and the generation of electricity, a transformation occurs within the fuel rods and surrounding "blanket"; this results in a phenomenon called "breeding" in which some of the uranium (U-238) is converted into plutonium (Pu-239). Since this plutonium is not expected to be used in this reactor, it will be sold back to the Atomic Energy Commission for other uses.

The term "breeding" applies only to this transformation of materials. It does not infer some kind of "reproductive process" of creating new energy for prolonging the operation of this reactor. The total energy resource which entered the reactor at the beginning of the cycle is, of course, reduced by the amount of heat energy which is consumed for the generation of electricity.

It was not until 1951 that private groups were permitted to undertake limited studies in the application of atomic energy for the production of electricity. Even then, however, such studies were essentially under the complete control of the Commission, and were subject to all of the then prevailing regulations of secrecy and other restrictions.

Continuation of Governmental Controls

Interest continued to develop in the application of atomic energy for civilian purposes, and this led to the passage of the Atomic Energy Act of 1954 (68 Stat. 919). The Act of 1954 was designed, as were subsequent amendments, to permit private industry to employ the new technology in the construction of a limited number of atomic power plants. Despite the relaxation in the governmental monopoly of atomic energy, however, the Government still retains the following functions:

(a) It is the sole producer of enriched material for fuels to be used in power reactors.

(b) It sets the price of nuclear fuel and is empowered to guarantee prices or waive its charges.

(c) It owns and controls many of the basic research centers concerned with atomic energy and the information released therefrom.

(d) It has the power to pre-empt ownership of all patents which pertain to atomic developments.

(e) It is a leading developer of various types of atomic power reactors.

(f) It subsidizes, or has some form of financial stake in virtually all of the atomic power plants, publicly

or privately owned, now in operation or under construction.

Limitations in Application of Engineering Responsibility

In retrospect it is quite apparent that the origin and growth of atomic power has followed a reverse sequence to that which has taken place in the development of the conventional sources of power—coal, oil, gas and water. In these compulsive circumstances, the engineering profession is confronted with the question of how to apply its traditional disciplines and responsibilities for public safety to the production of electricity under the following new conditions:

(1) The scientific principles of the atomic power reactor are understood by relatively few scientists, and by very few engineers.

(2) Only limited knowledge is available regarding the reactor's heat-producing characteristics in large quantities and over prolonged periods of time.

(3) An atomic power reactor is known to be a highly dangerous device, and its design and application must be developed with extreme care.

(4) No adequate record of operating experiences is available which might serve as a significant guide for the design of large power reactors.

(5) It is known that a major failure of a power reactor could do tremendous damage to life and property.

(6) The insurance companies are unwilling, in fact unable, to assume the full liability for any major

reactor failure, or to protect the owners and operators of the power reactor from damage and death claims following a reactor failure.

(7) The consequences of sabotage or deliberate inducement of a major failure in a power reactor could lead to tremendous damage to life and property; there is no clear prospect of developing a simple design which would protect the public against this contingency.

(8) The ultimate cost of a reactor power plant cannot be satisfactorily predicted and could, conceivably, overrun an estimate two or three times.

(9) It is known that the cost of producing electricity from an atomic power plant is several times greater than the cost of electricity from conventional steam plants. Furthermore, the cost of various items, such as nuclear fuel rods and the disposal of waste, contain government subsidies of unknown magnitude.

(10) From an engineering standpoint there is no economic justification for an atomic power plant.

(11) At best, if investment cost and operating cost were to be disregarded, an atomic power plant may be considered an experimental facility.

(12) The development and control of this new science is in the hands of the Federal Government, and anyone wishing to engage in it may be obliged to work under restrictive regulations and rules of secrecy. This is an unprecedented situation. The conventional and traditional atmosphere of free-

dom of exchange of knowledge among engineers does not prevail.

(13) There is no indication that a system of checks and balances in engineering responsibilities prevails in this new field.

(14) No legal structure within the accepted principles of the "rule of law" and the Constitution of the United States has been established with respect to this new area of science. (See comments on Rule of Law, *infra* pp. 53-54.)

IV. BASIC PROBLEMS IN POWER PLANT LOCATION

Electric energy is produced for the benefit of the consumer. It has the unique characteristic of portability by means of transmission lines, and where it originates is of no direct concern to the consumer. Hence, there is considerable freedom of choice in the location of generating (or power) plants. As a first step, and for comparative purposes, the criteria which generally govern the location of the conventional types of power plants are presented.

Choice of Location of a Thermal Power Plant

A coal-burning steam power plant may be located either at the mouth of a coal mine or adjacent to an industrial load center, the choice depending on whether it is more economical to transmit the electricity or to transport the coal between the mine and the load center. An oil-burning steam plant is usually located near the load center, because of the ease and economy of transporting oil in pipelines.

The detailed choice of location of the power plant and related fuel storage, and the detailed design of the high-

pressure steam boilers and all other components, is dependent upon well established engineering criteria which, in turn, are based on long records of experience in the operation of similar power plants throughout the country. Such engineering decisions must also meet with the approval of the insurance underwriters. This system of control of the safety features in design and location of thermal power plants has evolved from the free interplay of opportunity and responsibility brought about by private or local initiative, tested by experience, generally governed by sound economic considerations in their application, and, as the need arose, subject to regulatory controls by public utility commissions.

Another basic influence in this process of engineering development has been the record of failures and disasters in earlier power plants. It is part of the history of engineering that many of the most important advancements in the art have been developed from the lessons learned through the occurrence of major failures or disasters. Such failures obviously were not expected to occur. However, whenever they have occurred, the resources of the engineering profession have been mobilized to identify their cause and to establish modifications in engineering practice which have helped to prevent their recurrence. This is part of the slow and difficult process by which the art of engineering advances step by step and with due regard for the public's safety.

Choice of Location of a Hydroelectric Power Plant

There is less freedom of choice with respect to the location of a hydroelectric power plant. It must be located

where a river has a site which is favorable to economic development. Such a location may be hundreds of miles distant from the load centers, and the electric energy must be conveyed over long transmission lines to the consuming areas.

Choice of Location of an Atomic Power Plant

The possibility of a serious reactor failure introduces some overriding considerations in any decision involving the location of an atomic power plant. The failure of a reactor, which involves the release of radioactive material to the atmosphere, can inflict terrifying damage on the property and on the population which may be located in the vicinity. The magnitude and extent of such destruction will be discussed later in greater detail.

Furthermore, the operation of an atomic power reactor introduces some new problems with respect to waste disposal. Reactor waste products are highly radioactive and so dangerous that they must be permanently stored in inaccessible places. These problems have been solved only to a limited degree. At present there are no economical solutions available, and, of course, no experience to guide the engineering profession in this new area of responsibility.

Under these circumstances a professional engineer might undertake the design of an experimental atomic power plant of limited size and cost and apply the highest degree of skill and judgment to the design of all its elements. However, there would still remain the overriding problem of locating this new power plant so it could not become an undue hazard to public life or property.

The solution which could be regarded as most acceptable by responsible engineers would be to construct such a power plant at a remote location and within a cavern excavated far back in a solid rock formation; as in the case of many hydroelectric developments, the electrical output would be delivered over long transmission lines to the load center. This concept of design was actually developed by some of the world's most competent engineers and has been adopted as a requirement in some other parts of the world. It was assumed that, in the event of any major failure of the nuclear reactor, the passageway to the cavern would be permanently sealed off and the project could be abandoned, without having exposed life or property in the vicinity to harmful radioactivity.

A Failure in Professional Engineering Responsibilities

In the case before this Court, as will be indicated in greater detail, it is a regrettable fact that the conventional responsibilities of the professional engineer, and his overriding obligations to the public safety, have not been fully respected. Furthermore, the essentials of professional freedom and moral duty to serve the best interests of the public and of the country did not prevail. If professional freedom had prevailed, it is most probable that the project now being contested before this Court would not have been constructed at the present site.

Hence it must be said of this project that the *choice of location* is the result of a denial of professional freedom, and of a terrifying violation of engineering disciplines and ethics. To support such a broad declaration requires an examination of the circumstances which led to the choice

of the present location, and of the evidence which was available at the time regarding the potential hazards to the public.

If a remote location actually was recommended (as representing the best judgment of an independent consulting engineer), there is no evidence that such an opinion was considered acceptable, or that such independent and responsible judgment was invited. Furthermore, there is no evidence that the engineering profession publicly protested this violation of its professional disciplines and its stature before the public. The net result was that those responsible for construction of this project made the deliberate choice of a site in the vicinity of two large cities. The apparent reasons for this choice are without precedent and must be regarded as historically incredible. These are the basic issues which have brought the present case before this Court.

V. CRITERIA FOR SAFETY AND PUBLIC HEALTH

It is noteworthy that in all engineering, the criteria for design, or for the protection of health and safety, have of necessity been established in advance of full understanding of the related scientific principles. Much remains to be learned in all areas of engineering; this applies particularly in the area of public health. In this area the factor of safety has always been large and in favor of the public.

To cite a specific case, the supply of safe drinking water in every locality is an example, on a nationwide scale, of applied disciplines in engineering. The American system of water supply may truly be called a miracle. The con-

tinuity of such a standard of service demands constant vigilance and attention to many details on the part of thousands of engineers and employees in water works. Certainly, no one would advocate a lower standard of safety in water supply for the sole purpose of saving some money. It would be considered preposterous if a public official were to advocate a lower factor of safety and cheaper water supply on the premise that the community would be financially ahead, even if this were to result in an occasional contamination of the water—or outbreak of typhoid—or a "slight" rise in the death rate.

Criteria for Radiation Limits for Human Beings

> "It is only with research for criteria for radiation limits that one finds suggestions that it should be permissible to kill people to attain benefits to society. This has undoubtedly been in the minds of all criteria makers, but rarely has it reached the frank and stark pronouncements of recent years."

Thus testified one of the most competent living authorities in the field of sanitary engineering before the Joint Committee on Atomic Energy in 1960.[1] He continued:

> "Fear has been expressed that the establishment of too rigid criteria for the radiation activity may stifle progress because of excessive costs of attainment. One may view this fear with some cynicism in the light of the whole history of health and safety endeavor. This fear has always been expressed, but the historical realities consistently bely it. Criteria must rest upon upon health protection and not cost.

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[1] **Hearings on Radiation Protection Criteria and Standards: Their Basis and Use**, before Joint Committee on Atomic Energy, 86th Cong., 2d Sess. pp. 29-45.

"No one, of course, should advocate excessive and unnecessary restraints. Those restraints most logically suggested, however, within the framework of current scientific understanding should not be resisted solely because resulting costs may threaten to throttle application. This should be scrutinized with a great deal of care before it is accepted as a base line of decision.

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"The radiation field is today confronted with similar problems and decisions, greatly complicated by the very nature of the biological effects to be considered. The effects of radiation are unclear and not fully predictable with assurance, perhaps for some years. Yet one cannot bide one's time in placing restraints upon the public and private producer. These latter do not have an unblemished record of self-policing. Hence society must look to scientific groups and public officials for providing criteria and guides, at times admittedly uncertain, and others admittedly tentative. As knowledge increases, reappraisals ensue, either for relaxation or for tightening of criteria. These supposedly fumbling steps have much historical validity and precedent in public health practice. . . .

"The day of handbook rule for measuring the hazards of radiation is a long way off. In the meantime one acts upon limited knowledge. In such action the guiding principle must be the maximum protection of the people, not because of sentiment but because society demands it. An agreed acceptance of a number of consequent disabilities is not an appealing basis for the development, say, of nuclear power. Industry will do better than rest upon such an affront to man. I know they will, and have."

VI. REPORT OF ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

The problem of appraising the safety aspects of the Lagoona Beach project under "the guiding principles of maximum protection of the people" was assigned to an independent committee of scientists and engineers known as the Advisory Committee on Reactor Safeguards (ACRS). On June 6, 1956, this committee reported to the Atomic Energy Commission that it had reviewed the application of PRDC and had come to the conclusion that it could not approve the application.* Quoting from the report:

> "The proposed PRDC reactor represents a greater step beyond the existing state of the art than any other reactor of comparable power level which has been proposed by an industrial group.
>
> * * *
>
> "From this review the following conclusions were derived:
>
> 1. "Even though there are no facts or calculations available to the committee that clearly indicate that the proposed reactor is not safe for this site, the committee believes there is insufficient information available at this time to give assurance that the PRDC reactor can be operated at this site without public hazard.
>
> 2. "It appears doubtful that sufficient experimental information will be available in time to give assurance of safe operation of this reactor unless the present fast reactor program of the

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* Joint Committee on Atomic Energy. "A Study of AEC Procedures and Organization in the Licensing of Reactor Facilities." 85th Cong., 1st Sess. (Joint Committee Print 1957). p. 133.

AEC is amplified and accelerated as detailed below.

3. "It is impossible to say whether or not an accelerated program would give sufficient information to permit safe operation of this reactor at the Lagoona Beach site on the time schedule presently proposed.

* * *

"The Committee considers it important that bold steps be taken to advance the development of the fast breeder reactor concept and commends the willingness of the Power Reactor Development Company to risk its capital and prestige in advancing the development of this reactor concept. But the Committee does not feel that the steps to be taken should be so bold as to risk the health and safety of the public. It is important for the AEC to provide sufficient development facilities and experimental information that the safety aspects of the PRDC reactor can be reliably appraised in advance of operation of the reactor itself."

Unfortunately, this report was withheld from pubication and the conditional construction permit was authorized by the Commission on August 4, 1956. The report finally was released on October 9, 1956.

Questions Raised by Joint Committee on Atomic Energy

A major difference of opinion regarding this report developed between the Chairman of the Congressional Joint Committee on Atomic Energy and the Chairman of the Atomic Energy Commission.

On August 4, 1956, the Chairman of the Joint Committee issued a statement containing the following:[10]

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[10] Joint Committee on Atomic Energy, Supra note 9, pp. 125-126.

"AEC has informed the Joint Committee on Atomic Energy that it has issued a construction permit to PRDC of Detroit to construct a nuclear power plant near Monroe, Michigan. This is known as the Detroit Edison reactor.

"The issuance of this construction permit, in my opinion, sets a dangerous pattern in the early stages of AEC regulative and quasi-judicial activity for the following reasons:

"1. The AEC has issued this permit as a result of 'star chamber' proceedings in which the report of its Advisory Committee on Reactor Safeguards, which raised grave doubts as to the safety of the proposed reactor, has never been made public by AEC. It is my understanding that this important report, filed on June 6, 1956, which was prepared by a distinguished committee of experts, has not been retracted or modified by them.

* * *

"4. From a practical standpoint, AEC might feel obligated to go on through with a bad deal with respect to public safety because they will have permitted the expenditure of huge sums under the construction permit. It is my belief that decisions on safety should be made without any examination of dollars involved but only from the standpoint of human lives."

VII. PROBLEMS OF INSURABILITY

Traditionally the power industry has developed under laws which, in essence, hold the individual power companies responsible for any damages which their activities might inflict on the public. This concept of liability has proven to be a strong influence upon the industry in developing its

high record of safety. As a result, new scientific and technological developments have been adopted only after undergoing severe tests, and after adequate proof that the adoption of any new equipment would be consistent with the prevailing standards of safety.

A vital factor in this process has been the private insurance industry. For example, as boilers for steam power plants have increased in size and output, it has taken many decades to develop the responsible criteria of design under the constantly increasing temperatures and steam pressures. In such details as the metallurgy of the steel, welding and fabricating procedures, installation, operating controls, and safety devices, the great traditions of responsibility in engineering and in manufacturing have served as a foundation for taking each progressively higher step. In all of this development the insurance industry has participated with clear understanding of its responsibilities, and has insisted on the application of sound engineering disciplines before it would assume the liability for public damage due to explosions or other accidents.

In the atomic power field, on the other hand, the insurance companies were confronted with a new peril in which experience is almost totally lacking. At the same time they were confronted with demands for coverage of unprecedented magnitude. After considerable study the private insurance industry was obliged to announce that it would be unable to offer satisfactory public liability insurance on atomic power installations. The position of the private insurance industry was summarized in a comprehensive report from which the following is quoted:"

"Hearings on **Governmental Indemnity** before Joint Committee on Atomic Energy, 84th Cong., 2d Sess. pp. 248-250.

"The hazard is new. It differs from anything which our industry has previously been called upon to insure. Its potential is still unknown and must therefore be calculated currently in terms of a body of knowledge which is expanding from day to day.

"Very few insurance companies have had any opportunity to develop first-hand knowledge of the problems involved because of the present limited scope of operation. By the same token, very few insurance companies have developed trained technical personnel to assist their underwriting personnel in insurance evaluation of the hazards involved.

"The catastrophe hazard is apparently many times as great as anything previously known in industry and therefore poses a major challenge to insurance companies. . . . We have heard estimates of catastrophe potential under the worst possible circumstances running not merely into millions or tens of millions but into hundreds of millions and billions of dollars. It is a reasonable question of public policy as to whether a hazard of this magnitude should be permitted, if it actually exists. Obviously there is no principle of insurance that can be applied to a single location where the potential loss approaches such astronomical proportions. Even if insurance could be found, there is a serious question whether the amount of damage to persons and property would be worth the possible benefits accruing from atomic development."

Catastrophe Hazards.

In addition to the damage to the power plant and operating personnel from a conceivable accident in an atomic reactor, the far greater hazard lies in the radiation exposure and contamination which could occur if the fission products should be released to the surrounding area. It is

conceivable that accidental atomic or chemical reactions within the reactor or auxiliary systems could destroy equipment, break the containment structures, and release the accumulated fission products to the atmosphere in a highly divided state. Once airborne, these toxic products could be widely dispersed, threatening the health and safety of people over wide areas. The danger may be emphasized by noting that some radioactive materials are more than a million times as toxic as chlorine, the most potent common industrial poison.

Naturally, the Atomic Energy Commission, as well as the manufacturers and public utilities engaged in atomic power development, have been deeply concerned over the type and amount of damage to people and property which could occur in the event of a major catastrophe, and with the problems of settling the ensuing damage claims.

In March 1957 the Atomic Energy Commission published a report which is generally known as the Brookhaven Report: "Theoretical Possibilities and Consequences of Major Accidents in Large Nuclear Power Plants."[12] This report contains the studies of an "assumed condition of accidental failure" of an atomic reactor with an electrical power capacity of 100,000 to 200,000 kw and located on a river about 30 miles from a major city. Various assumptions and conditions of the surrounding region were defined to provide some basis for computation. It must, of course, be kept in mind that some of the problems involved are extremely difficult to analyze. However, the figures were intended to serve as an "order of magnitude" indica-

[12] "Theoretical Possibilities and Consequences of Major Accidents in Large Nuclear Power Plants." ("Brookhaven Report"). R. 874-917.

tion of the possible consequences of a major reactor failure. Such a failure could result in contamination of large areas from deposited fission products. Inhabitants of portions of the areas affected would have to be evacuated to avoid serious exposure. Standing crops would be lost. Agricultural use would be curtailed. Access to various areas would be restricted for considerable periods of time.

The results of these studies indicated that, depending upon the weather conditions and temperature of the released fission products for the assumed accident, the property damage alone could range between $2,300 million and $4,000 million and possibly higher. Damage to health and life could be in the order of 43,000 injuries and 3,400 fatalities, without taking into account the probability of harmful long-term effects on several hundred-thousand people. The financial liability for human casualties was not evaluated and obviously is beyond comprehension.

It might well be wondered, under these circumstances, how any agency engaged in the generation of electricty could afford to undertake the construction of an atomic power plant when faced with the possibility of becoming liable for such vast potential damages.

Government Acceptance of Liability

Eventually the private insurance industry, after pooling all its resources, committed itself to underwriting liability coverage on a single atomic power installation in the amount of $60 million. However, this represents only a small fraction of the potential damage to life and property from a major failure of an atomic reactor.

To resolve this impasse, a proposal was advanced which must be regarded as a great historical tragedy in the affairs of our government. The Atomic Energy Commission chose to recommend to the Congress—and the Congress saw fit to enact—legislation by which the liability, except for the comparatively small coverage provided by the private insurance industry, was transferred to the taxpayers of the nation. The 85th Congress adopted Public Law 85-256, known as the "Price-Anderson Act," which added Section 170 to the Atomic Energy Act of 1954. This Act was approved on September 2, 1957. (42 U. S. C. 2210)

Under this Act the United States Government has assumed a liability which is stated as a maximum of $500 million for each accident. However, in view of the commitment in principle, it is difficult to visualize how the Government could escape a much greater liability in the event of a larger disaster. The possibility of such a disaster occurring, obviously, has been acknowledged by the passage of this amendment. Representatives from the power and manufacturing industries had stated that without such assumption of liability by the government they would not be able to continue their participation in the atomic power program.

The enactment of these indemnity provisions into law, however, has not eliminated the hazard. It has served only to relieve the individual power companies and the manufacturers of the traditional system of financial liability by transferring such liability to the Federal Government. In this manner the way was paved for building so-called "low-cost atomic power plants" near the load centers. Following enactment of the Price-Anderson Act, a number of publicly and privately owned atomic power plants have been under-

taken with governmental approval near populous areas, thus subjecting the people, without their consent, to unnecessary and unprecedented hazards. The ultimate liability in the event of a disaster has been transferred, according to law, to the nation's taxpayers.

The net result of this action has been to circumvent and disrupt the traditional system of disciplines and responsibility of the engineering profession. As has been previously stated, the public has great confidence in the engineering profession to protect the public health and safety, and professional engineers are expected to assume their responsibilities and serve under the highest standards of ethics and intellectual honesty. However, these standards cannot prevail under a system of government indemnity which displaces such responsibilities.

Probability of An Atomic Disaster

It has been alleged that the location of an atomic power plant near a populated area is permissible on the grounds that the many safety precautions taken to avoid an accident render the possibilities of an atomic disaster "exceedingly improbable." However, as noted previously, such assurances in no way alter the fact that virtually every major accident or disaster which has occurred in past history has been "exceedingly improbable."

History has clearly demonstrated that man, with his imperfections, has never been able to foresee all future technical events. Despite his best efforts, failures have occurred; at the same time, he has used these failures to increase his knowledge and widen his range of confidence. In the face of this long-established historical fact, the atomic

energy program is currently being promoted on the assumption that a major accident will not occur. However, despite the excellent technical efforts which have been applied to date, such an assumption, particularly in view of the completely new technology involved, must be regarded as utterly unrealistic.

Failures in the Field of Atomic Energy

Although the atomic energy industry is very young and has relatively few installations, it has achieved an impressive record of safety in its brief history. In fact, it seems doubtful that any other industry can show greater concern for safety in terms of time and effort, or money expenditures. However, reassuring as this fact may be, it is also significant that despite this safety effort, failures are still occurring. Such failures range from relatively minor ones to the more serious. In most cases the reactors which have failed have been relatively small. Some of the failures in the operation of atomic reactors have resulted in deaths, or have exposed considerable numbers of persons to radiation.

A failure occurred in December 1950 at the National Research Experiment (NRX), Chalk River, Canada, which resulted in a nuclear runaway and explosion. This accident is not widely known because the security regulations at the time of the incident were very strict; but it resulted in the death of one man and the serious radioactive contamination of five others.[11]

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[11] Hayes, D. F. "AEC Experience in Radiation Accidents." In **A Compendium of Information for Use in Controlling Radiation Emergencies."** U. S. Atomic Energy Commission. Report TID-8206 (Rev.). September 1960. pp. 2-3.

At Windscale, England, in 1957 a fire in an atomic reactor resulted in the widespread release of radioactive material over the surrounding countryside. It fell on the pasture lands of farms in a 200-square-mile area. The cows, while grazing, absorbed the fallout of iodine-131; it reappeared in the milk. Fortunately this was discovered almost immediately by scientific monitoring, and resulted in a ban on the use of all milk produced in this area. It was considered advisable to dump all the milk for a period of two months to prevent its consumption by young children who might otherwise have accumulated significant quantities of radioactive iodine in their thyroid glands. The report of the board of investigation stated that the cause of the accident was due partly to inadequacies in the instrumentation provided for the control of operations, and partly to faulty judgment by the operating staff, these failures in judgment being themselves attributable to weaknesses of organization."

Although both of these failures, among a number of others, have occurred outside the United States, published accounts have recorded 39 failures in reactors of various types in this country.

On January 3, 1961, about 9 p. m. a failure occurred near Arco, Idaho, in an AEC prototype power reactor rated at 200 kw. This resulted in the death of three persons who were working on the reactor at the time of the accident. Prior to this failure it was known that a variety of troubles had developed, some having their origin in the design and others in the operation of the reactor. Because of the high

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"Accident at Windscale No. 1 Pile on 10th October, 1957." Presented to Parliament by the Prime Minister by Command of Her Majesty. November 1957. Cmnd. 302. London. HMSO

radiation levels inside the building, it has not been possible to enter and determine the cause of the failure.

The AEC report of January 27, 1961 states:

> "Because of the high radiation levels, it was not possible to remove the second crewman until January 5, and the third crewman until January 9."
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> * * *
>
> "At this time it is not possible to identify completely or with certainty the causes of the incident. The most likely immediate cause of the explosion appears to have been a nuclear excursion resulting from motion of the central control rod. As yet there is no evidence to support any of several other conceivable initiating mechanisms."[1]

These and other failures provide impressive evidence that no matter how great an effort may be made to prevent them, accidents will occur. This is particularly true in the development of a technology as new as atomic energy—much still remains to be learned.

Steel Containment Vessel

During the early 1950's there was considerable discussion on how to design an unprecedented type of power plant containing an atomic reactor. As a basic principle it was generally agreed that every effort should be made to minimize the hazard to the public as much as possible.

It had been determined that any release of fissionable material to the atmosphere could have a terrifying and dis-

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[1] "Interim Report on the SL-1 Incident." Report of the General Manager's Board of Investigation. U. S. Atomic Energy Commission. January 27, 1961. pp 2, 11.

astrous result on public life and property in the vicinity. The possibility of such an occurrence, no matter how remote it might be, had to be admitted. These considerations eventually led to a proposal to construct a steel plate "containment shell" or dome completely surrounding the reactor unit. This dome presumably would confine whatever cloud of fissionable material might otherwise be released to the atmosphere. The dome at the PRDC (Enrico Fermi) atomic power plant at Lagoona Beach consists of a steel shell 72 ft. in diameter, 120 ft. high, and with varying thicknesses of steel plate from 0.52 to 1.25 inches.

Such a structure has become a highly controversial design concept and there is a considerable body of professional engineering judgment that it is of extremely limited value in safeguarding the public.

It could be claimed that the design of this dome has had the benefit of a careful review by the United States Naval Ordnance Laboratory in White Oak, Maryland. However, an examination of this report indicates that it does not claim to be a comprehensive treatise on the containment problem for this reactor power plant, and that many of the containment problems that are peculiar to this reactor have never been solved either experimentally or theoretically.

The limitations and reservations noted in this report reveal that the authors and the officers of the U. S. Naval Laboratory recognize the tremendous responsibilities involved in the over-all project. They have stressed the fact that their participation in a limited study area may not be regarded inferentially as approval of many other important areas which have not been studied. This sense of respon-

sibility is in keeping with high professional engineering standards and is worthy of commendation. (It is regrettable that this report has not been given the degree of recognition commensurate with its importance.)

The following quotations from the Abstract of this report indicate the great care with which the U. S. Naval Laboratory approached this problem:

> "A study has been made on the ability of the Enrico Fermi fast breeder reactor plant to contain a nuclear excursion equivalent to the violence produced by 1,000 pounds of TNT. The results of the study indicate that the reactor plant can contain shock waves developed in the air and in the sodium and also fragments from the cylindrical covering materials surrounding the reactor core. The rotating shield plug, however, is a serious hazard when projected by the gun action of the internal blast pressure in the reactor compartment. This problem is analyzed and a recommendation has been made to lessen the danger.
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> * * *
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> "This report is not claimed to be a comprehensive treatise on the containment problem for this reactor plant. To do so would go far beyond the intended scope of this study. *Many of the containment problems that are peculiar to this reactor have never been solved experimentally or theoretically.* Conclusions that have been made are based on concepts taken from applicable areas of explosions research.
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> "It is emphasized that this entire report is *based on information furnished* by the Atomic Energy Commission that the most probable upper limit of energy release from a power excursion of this reactor is estimated to be 4.54 times 10^8 calories. *Within this limita-*

tion and others noted here and elsewhere in the text, this report is presented for information purposes."[10] (Emphasis added)

The limited value of the containment shell or dome, from the standpoint of public safety, is particularly understood by those who have some appreciation of the consequences of sabotage or other possibilities of planned destruction. (Some descriptions of its protective value are reminiscent of the Middle Ages and indicative of the controversial nature of this design concept.)

"Compelling Reasons" Criterion is Sound and Desirable

One of the questions before this Court is whether the Commission must establish "compelling reasons" before it can approve the location of a reactor near a heavily populated area. However, the petitioners claim that this would "seriously impede and, in significant areas, might even block the programs and policies that the Atomic Energy Commission had carefully developed" with regard to atomic power development in this country.[11]

In view of the dangers in an atomic power plant, as acknowledged by the passage of the Indemnity Act, it is difficult to visualize any "compelling reasons" which could be cited in support of locating a reactor power plant near a populated area. It may be argued that to require the location of an atomic plant in a remote area would result in greater cost of such power to the consumer, and thus

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[10] **"Containment Study of the Enrico Fermi Fast Breeder Reactor Plant."** U. S. Naval Ordnance Laboratory, White Oak, Maryland. NAVORD Report 5747. 7 October 1957. pp. i-ii.

[11] Petition for a Writ of Certiorari filed by the Government and AEC, No. 454, This Term, p. 11.

postpone the day when atomic power would be economically competitive with thermal or hydro power. However, such an argument lacks merit for three important reasons: (1) It tends to disregard the question of public health and safety; (2) references to atomic power becoming "economically competitive" with electricity produced by conventional means are meaningless because no acceptable basis for comparison of costs between the two methods is available;[1] and (3) it ignores the fact that hydroelectric plants, of necessity, frequently are located at great distances from the service areas.

While it may be argued that the possibilities of an atomic disaster are "believed" to be extremely remote, any effort to claim this as sufficient justification for locating an atomic power plant in the vicinity of a populated region must be regarded as a gross violation of professional engineering responsibilities. To ignore available alternatives and knowingly to expose a large population to a hazard of unprecedented magnitude, however remote its occurrence may seem, must be regarded as a gross violation of moral and ethical standards, not only in engineering but also in industry and in government. For a government or its agency to violate such standards and, in addition, to offer incentives which contribute to the violation of such standards, must be regarded as a revolutionary departure from the fundamental principles established by the Constitution of the United States.

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[1] All of the cost components of conventional power plants are determined through the competitive operations of a free market. On the other hand, many of the comparable costs of atomic power plants are established administratively by governmental authority.

VIII. A SILENT REVOLUTION IN OUR FORM OF GOVERNMENT

In this technological age the influence of the scientist and of the engineer (the experts) has assumed tremendous importance in governmental affairs. It may not be remiss at this point to call attention to the relatively simple device by which the highly complex field of science and technology, when dominated by governmental authority, can be applied over a period of years to the introduction of revolutionary changes in our form of government. This is particularly true where we find displacement of independent professional responsibilities, or where a commission is so constituted that it regulates its own acts. It is out of such procedures that a new system of "administrative law" is born. Over the years this tends to grow up to form a new legal structure in place of our conventional system of the "rule of law"—and generally beyond the reach of Constitutional controls and our judicial system. We have been warned that eventually such a legal structure can deteriorate into "administrative lawlessness."

The trend towards administrative procedures and law was clearly outlined by the late Lord Chief Justice of England in 1929:"

> "Two main obstacles hamper the beneficent work of the expert. One is the Sovereignty of Parliament, and the other is the Rule of Law.
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> "A kind of fetish-worship, prevalent among an ignorant public, prevents the destruction of these ob-

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"Hewart of Bury, Rt. Hon. Lord. Lord Chief Justice of England (dec.). **The New Despotism.** (Ernest Benn, Ltd., London), pp. 20, 23.

stacles. The expert, therefore, must make use of the first in order to frustrate the second.

"To this end let him, under Parliamentary forms, clothe himself with despotic power, and then, because the forms are Parliamentary, defy the Law Courts.

"This course will prove tolerably simple if he can: (a) get legislation passed in skeleton form; (b) fill up the gaps with his own rules, orders and regulations; (c) make it difficult or impossible for Parliament to check the said rules, orders and regulations; (d) secure for them the force of statute; (e) make his own decisions final; (f) arrange that the fact of his decision shall be conclusive proof of its legality; (g) take power to modify the provisions of statutes; and (h) prevent and avoid any sort of appeal to a Court of Law."

In this same essay the following warning has been sounded:

"It is, or at any rate it was until quite recently, a commonplace to say that the 'Rule of Law' is one of the two leading features which distinguish our Constitution. So it has been ever since the eleventh century, and, if this leading feature or essential characteristic is to be diminished or destroyed, it seems at least desirable that the work of diminution or demolition should be openly and frankly performed, with the British public standing by, fully instructed and deliberately consenting. Nothing could well be more unfortunate than that a change of so fundamental a character should be brought about piecemeal, by subterranean methods, which might escape general observation until the mischief had been carried to completion."

IX. ISSUES RELEVANT TO THE QUESTIONS BEFORE THE COURT

1. Technology has clearly emerged as a mighty shaper of human destiny. With the development of science and engineering to this dominant role, scientists and engineers have the responsibility of opposing the harmful exploitation of these powerful influences.

2. The two areas of responsibility, as between science and engineering, must be clearly understood. *Scientific truth* is naked truth. A scientific principle is a naked principle. *Engineering truth* is fully clothed in ethics and morality. It is founded on the proposition of individual responsibility. In the application of scientific principles the engineer is expected to serve the public interest with due regard for the preservation of the Rule of Law and our Constitutional system of government. In developing new plans for the future, the engineer interprets the experiences of the past and adds the vital ingredients of imagination, sound judgment and integrity.

3. The atomic age has brought out a major biological factor in our world. The development of atomic power installations has brought with it the problem of radioactive hazards which is becoming an ever increasing danger to human life. In the application of this new science, safety of human beings is the most important consideration. Nuclear radiation not only endangers their immediate health, but also may harm or destroy their offspring.

4. The operation of a large atomic power plant involves many people; a failure in its control can occur at human hands by careless handling, lack of experience, by

accident, or by criminal action such as theft or sabotage. Failure can also occur through errors in design of the complex and highly technical apparatus. A general release of radioactive materials, as has already happened, allows them to be spread over the countryside and into the rivers, ultimately reaching man through water and food of all types. "With all the inherent safeguards that can be put into a reactor, there is still no foolproof system. Any system can be defeated by a great enough fool. The real danger occurs when a false sense of security c' uses a relaxation of caution."[20]

5. The individual scientists and engineers, as well as the leaders in their professional societies have a traditional responsibility of presenting truthful information on both successes and failures in their work and to protest against efforts to misuse their services. Unfortunately the field of atomic power is suffering from lack of interest and concern on the part of most engineers, and from lack of responsible leadership. Furthermore, it is clouded by a variety of professional papers and publications, many of which are misleading or purely propaganda. The lessons of experience in this field are in their embryonic stage and, as the National Academy of Sciences has stated: "Present experiences give us only a shadow of a presentiment of what is yet to come."

6. The atomic power plants which for the most part are being undertaken by private industry at a loss are intended to develop technical knowledge and experience. "There was always a sort of threat, however, that if pri-

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[20] McCullough, C. Rogers, Chairman of Advisory Committee on Reactor Safeguards, AEC. "The Safety of Nuclear Reactors," in **1955 Geneva Conference Proceedings** (New York, United Nations, 1956) Vol. 13, p. 79.

vate industry did not do so the government would build the plants itself. What, if any, influence this had upon private industry's decision it is not possible to say."[21]

7. The threat of government competition to gain political objectives has been the subject of much discussion, as for example:

> "There can be little doubt, when government owns and operates a significant proportion of the capacity to produce electric power, that it gives to the government a greater ability to dominate and manage other economic activities. Those who favor centralized economic planning (or socialism in the sense of government ownership and operation of the basic industries), are naturally concerned about the role of government in the atomic industry. In the United States, the socialist voice seems to make itself heard by means of the public power advocates in our national legislature, who desire to retain nuclear produced electric power as a national monopoly. If this is possible, not only for electric power but for other aspects of atomic energy as well, the degree of central direction of all economic affairs would be increased and facilitated. . . ."[22]

8. The tendency of technicians to favor centralized planning was examined a few years ago, with great clarity and understanding.[23]

9. It is an ominous spectacle to see governmental authority taking charge of scientific discovery, and undertaking public developments without the benefit of an inde-

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[21] "Atomic Energy in a Free Society." Paper presented to Mont Pelerin Society, September 7-12, 1959. In **"Il Politico,"** University of Pavia (Italy), 1960, Vol. XXV, No. 2, p. 296.

[22] "Atomic Energy in a Free Society," supra, note 21.

[23] **Hayek, F. A. "The Counter-Revolution of Science."** Free Press, Glencoe, Illinois, 1952. See esp. Chapter 10, "Engineers and Planners."

pendent and responsible engineering profession to provide the moderating controls of ethics, morality and justice. This could eventually lead to the destruction of our form of government.

10. History has taught us that when political leaders and administrators in authoritative positions find themselves captivated by the premature application of scientific principles, and choose to take overriding control of them for the purpose of gaining high influence or domination over people and nations, without regard to the hazards or harmful consequences, they are practicing a system of usurpation and immorality in government, and are betraying a public trust.

11. The fundamental issue before this Court is not the simple question whether a specific atomic power plant should or should not have been constructed at a particular site. The basic issues are:

(a) Shall the Government of the United States, by legislation and administrative decision, engage in and foster the application of scientific principles under policies which violate the elementary codes of ethics, morality and justice which have been established by our founding fathers?

(b) Shall the Government of the United States, by the threat of direct competition with its citizens and under its own special rules, place in a defensive position those who are engaged in upholding our system of free and private enterprise under competent State regulatory controls?

(c) Shall the Government of the United States, without the full knowledge and understanding of all its citizens, provide special inducements and incentives for corporations and individuals to engage in the unsound application of scientific principles which contain the hazards of destruction of great numbers of human lives?

(d) What are the responsibilities of scientists and engineers who encourage or condone the enactment of laws for the building of atomic power plants where they will stand as constant threats of disaster to a large number of people at some unexpected time?

12. Whatever may be argued as having been the intent of Congress in the enactment of certain legislation, it must be assumed that Congress expected the highest standards of professional engineering to be maintained for the health and safety of the public. Furthermore, it is evident that any legislation which creates a conflict with the essentials of professional freedom, or which invites a relaxation of professional standards, can be rectified.

13. It is high time we face up to the hypocrisy of our assumptions, and that we express an angry and solemn warning against varieties of intellectual corruption. We must learn to say "No" to both client and cash when the proposition turns out to be something less than the best. The abandonment of principle for expediency is an advanced symptom of the decay of popular institutions, and the plain fact is that the sickness of an acquisitive society has become so acute we must either redeem it or perish.

We must take a moral and principled stand against sacrificing the future of our children and of our children's children and against depriving them of the freedom which is their birthright.

14. Science can provide the answer to many questions but beyond science is God who made both man and science. Man is only beginning to discover science but he is now learning that he can survive on this earth only if he applies science for the benefit of mankind according to the Will of the Creator of all things.

CONCLUSIONS

(1) This Court should find the Atomic Energy Act of 1954 precludes the Atomic Energy Commission from approving a site for an atomic power reactor near a populated area.

(2) The Commission, in granting a permit for the construction of an atomic power reactor, should be required to make adquate findings with respect to the safety of its operation.

(3) The general problems of public policy in the field of atomic power call for re-examination.

(4) Renewed emphasis is needed that our Constitutional form of Government must be respected and defended in the development of modern science.

GENERAL ACKNOWLEDGMENT

In addition to the specific references which have been cited in support of this brief, a comprehensive search has been made in a wide range of publications to gather basic facts in philosophy, engineering and human welfare. The synthesizing of this heritage of the past with the issues of today has, in essence, been a process of engineering design, similar to that employed in designing a bridge. Therefore, a general acknowledgment must be included to all who in the past have sought to show the way toward wisdom and understanding.

Respectfully submitted,

ADOLPH J. ACKERMAN
Consulting Engineer
1250 Sherman Avenue
Madison 3, Wisconsin

Of Counsel:

R. M. STROUD
1 West Main Street
Madison 3, Wisconsin

SUPREME COURT OF THE UNITED STATES

Nos. 315 AND 454.—OCTOBER TERM, 1960.

Power Reactor Development Co., Petitioner, 315 *v.* International Union of Electrical, Radio and Machine Workers, AFL–CIO, et al. United States, et al., Petitioner, 454 *v.* International Union of Electrical, Radio and Machine Workers, AFL–CIO, et al.	On Writs of Certiorari to the United States Court of Appeals for the District of Columbia Circuit.

[June 12, 1961.]

MR. JUSTICE BRENNAN delivered the opinion of the Court.

This case is the first contested licensing proceeding to be decided by the Atomic Energy Commission under the Atomic Energy Act of 1954, 68 Stat. 919, 42 U. S. C. § 2011 *et seq.* It presents the question whether the Commission erred in continuing in effect a provisional construction permit which authorizes the petitioner Power Reactor Development Company to construct, but not to operate, a fast-neutron breeder reactor for the generation of electric power. The Court of Appeals for the District of Columbia Circuit set that order aside. 280 F. 2d 645 (1960). We granted certiorari, 364 U. S. 889 (1960), on petitions of the United States and of Power Reactor Development Company (hereafter PRDC), to decide an important question of the scope of the Commission's power under the Atomic Energy Act of 1954.

Stated more precisely, the question before us is whether the Commission, in issuing a permit for the construction of a facility which will utilize nuclear materials, such as the power reactor presently involved, must make the same definitive finding of safety of operation as it admittedly will have to make before it licenses actual operation of the facility. The Court of Appeals said: "It is undisputed that the Commission must make such a finding when it authorizes operation. The question is whether it must make such a finding when it authorizes construction. In our opinion it must." 280 F. 2d, at 648. Petitioners agree that some finding directed to safety of operation must be made at the construction-permit stage of the proceeding, but argue that the Court of Appeals erred in holding that the Commission must have the same degree of certitude at this preliminary point as when it licenses operation. In order to understand how the controversy arises and what is involved in its resolution, it will be necessary to state the proceedings in the case at some length, and then describe in detail the governing statute and administrative regulations. For the decision of this case ultimately turns on a comparison of what the Commission found with what the statute and regulations require.

The case began on January 7, 1956, when PRDC filed with the Commission (hereafter sometimes referred to as the AEC) an application to construct and operate a developmental power reactor of a relatively new type. This device has two characteristics which distinguish it from other nuclear reactors. First, the neutrons which fly about inside the reactor (to use crude but graphic layman's terminology) and split atoms of fissionable Uranium–235—thus releasing new neutrons and energy in the form of heat—are "fast" neutrons. That is, they travel at a velocity of about 10,000 miles per second, much faster than neutrons in ordinary reactors. Second, this

reactor is a "breeder": it has the property of being able to produce about 1.2 times as much fissionable material as it consumes. This result comes about through a sort of modern alchemy; when the neutrons fly outside the inner core of the reactor, which is composed of fissionable U–235, they enter a blanket of nonfissionable U–238. Atoms in this blanket are changed, when struck by a neutron, into Plutonium, itself a fissionable fuel which can be removed from the reactor and be put to possible use in other installations. Thus, the reactor "breeds" Plutonium faster than it uses up U–235. It not only generates energy to produce electric power, it also creates new reactor fuel. This "breeder" effect is attainable because of the use of fast neutrons. Two boron control rods inserted into the reactor are a means designed to reduce its power level at any time. And in addition to these rods, eight more boron rods are suspended by an electromagnet over the reactor; in case the reactivity rises to a dangerously high level, these safety rods are intended to drop into the reactor automatically and shut it down immediately. The whole machine is housed in a series of thick concrete, graphite, and steel layers, all underground. Over this entire complex is placed a football-shaped building, enclosed in a two-inch steel shield capable of containing an explosion equal in force to 1,000 pounds of TNT, which is greater than any explosion which any of the experts who testified in this case believes is at all likely to result from an accident in the operation of the reactor. The application, after describing the reactor in much greater detail than this rudimentary summary, went on to provide that the reactor would be located at Lagoona Beach, Mich., on the shores of Lake Erie, about 35 miles from the center of Detroit, Mich., and about 30 miles from the center of Toledo, Ohio.

The Commission took the case under advisement and, on August 4, 1956, despite a report of its Advisory Com-

mittee on Reactor Safeguards which was at best noncommittal about the probable safety of the proposed reactor in operation, issued a provisional construction permit without having held public hearings, as the law at that time permitted it to do. This permit was subject to the following condition:

> "The conversion of this permit to a license is subject to submittal by PRDC to the Commission (by amendment of the application) of the complete, final Hazards Summary Report (portions of which may be submitted and evaluated from time to time). The final Hazards Summary Report must show that the final design provides reasonable assurance . . . that the health and safety of the public will not be endangered by operation of the reactor . . . ."

On August 31, 1956, in accordance with the Commission's then existing rules of practice, the respondents in this Court, International Union of Electrical, Radio, and Machine Workers, United Automobile, Aircraft, and Agricultural Implement Workers of America, and United Papermakers and Paperworkers, petitioned the Commission for permission to intervene and oppose continuation in effect of PRDC's provisional construction permit. The AEC granted permission to intervene on October 8, 1956, and set the case down for a hearing before one of its hearing examiners. Extensive hearings were held between January 8, 1957, and August 7, 1957, and on November 22, 1957, in accordance with the AEC's order setting the case for hearing before him, the examiner, instead of issuing an initial decision and opinion of his own, transferred and certified the record of the hearings to the full Commission for its consideration. Oral argument was had before the Commission on May 29, 1958. On December 10, 1958, the Commission rendered its "Opinion and Initial Decision" continuing PRDC's permit in effect, subject to the same condition recited above.

To its opinion were appended extensive findings of fact, including Finding 22, which is of central importance to the decision of this case. That findings read as follows:

> "22. The Commission finds reasonable assurance in the record that a utilization facility of the general type proposed in the PRDC application and amendments thereto can be constructed and will be able to be operated at the location proposed without undue risk to the health and safety of the public."

Commissioners Vance and Floberg joined in the opinion. Commissioner Graham filed a short concurring opinion agreeing with the Commission's basic safety findings, just quoted, but doing so in much shorter compass than the majority. Commissioners Libby and McCone (the chairman) took no part in the decision. The result of this initial opinion was an order continuing PRDC's provisional construction permit in effect, but containing the same condition which the original permit, issued on August 4, 1956, had contained.

The intervening unions, as was their right, filed detailed exceptions to this initial decision. The Commission fully reconsidered all the contentions and reviewed the evidence presented at the lengthy hearings, with particular attention to the testimony of the scientific experts, several of them members of the Advisory Committee on Reactor Safeguards, who had testified. On May 29, 1959, the Commission issued its "Opinion and Final Decision," dealing with all questions presented in even greater detail and reaffirming its initial decision. The Commission emphasized that "public safety is the first, last, and a permanent consideration in any decision on the issuance of a construction permit or a license to operate a nuclear facility." Even after operation of the reactor is licensed—if it ever is—the Commission, it said, will retain jurisdiction over PRDC's activities to ensure that the

highest safety standards are maintained. The opinion went on to examine the suitability of the proposed site, noted that it was near a great population center, and nevertheless concluded that at the present stage there was reasonable assurance that the general type of reactor proposed by PRDC would be safe enough at that location. The Commission pointed out, however, that its action in allowing PRDC to proceed with construction was by its nature tentative and preliminary, and that it was by no means committed to the issuance of an operating license. "PRDC has been on notice since before the first shovel of dirt was turned," it said, "that its construction permit is provisional upon further determination of many technological facts, including the complete safety of the reactor." A more severe safety test would have to be passed when the reactor was completed, the opinion said, since "the degree of 'reasonable assurance' . . . that satisfies us . . . for purposes of the *provisional* construction permit would not be the same as we would require in considering the issuance of the *operating* license." The Commission then made new findings of fact, including the following counterpart of its initial Finding 22:

> "22. The Commission finds reasonable assurance in the record, for the purposes of this provisional construction permit, that a utilization facility of the general type proposed in the PRDC application and amendments thereto can be constructed and will be able to be operated at the location proposed without undue risk to the health and safety of the public."

All three of the Commissioners who took part in the case joined in this final decision, and the Commission entered its final order continuing in effect the PRDC provisional construction permit, but again subject to the condition that a more extensive safety investigation, and a definitive safety finding, would have to be made before operation was permitted.

The intervening unions, respondents in this Court, then petitioned the Court of Appeals for the District of Columbia Circuit to review and set aside this order of the Commission. Only the final order continuing the permit in effect was drawn in question. No complaint was made of the original *ex parte* grant of the permit in 1956. PRDC intervened in the Court of Appeals in support of the AEC. On June 10, 1960, by a divided vote, a three-judge panel of the Court of Appeals set aside the AEC's order and remanded the case to the Commission. A petition for rehearing *en banc* was denied, two judges dissenting, and we brought the case here.

We turn now to an examination of the statutes and regulations pursuant to which the Commission purported to continue in effect PRDC's construction permit. The basic provision is § 104b of the Atomic Energy Act of 1954, 42 U. S. C. § 2134 (b), which authorizes the AEC to "issue licenses to persons applying therefor for utilization and production facilities involved in the conduct of research and development activities . . . . In issuing licenses under this subsection, the Commission shall impose the minimum amount of such regulations and terms of license as will permit the Commission to fulfill its obligations under this chapter to promote the common defense and security and to protect the health and safety of the public . . . ." Two things about this section should be emphasized. First, there is no doubt that the term "licenses" as used therein includes the provisional construction permit which PRDC has received. The last sentence of § 185, 42 U. S. C. § 2235, expressly so provides, as we shall soon see. And second, there is also no doubt that construction permits like all other licenses can be issued only consistently with the health and safety of the public. But the responsibility for safeguarding that health and safety belongs under the statute to the Commission. And § 104b, especially when read in connec-

tion with the general rule-making power conferred by § 161i (3), 42 U. S. C. § 2201 (i) (3), clearly contemplates that the Commission shall by regulation set forth what the public safety requires as a prerequisite to the issuance of any license or permit under the Act.

The issuance of construction permits is subject to § 185, 42 U. S. C. § 2235. That section provides that

> "All applicants for licenses to construct or modify production or utilization facilities shall, if the application is otherwise acceptable to the Commission, be initially granted a construction permit. The construction permit shall state the earliest and latest dates for the completion of the construction or modification. Unless the construction or modification of the facility is completed by the completion date, the construction permit shall expire, and all rights thereunder be forfeited, unless upon good cause shown, the Commission extends the completion date. Upon the completion of the construction or modification of the facility, upon the filing of any additional information needed to bring the original application up to date, and upon finding that the facility authorized has been constructed and will operate in conformity with the application as amended and in conformity with the provisions of this chapter and of the rules and regulations of the Commisson, and in the absence of any good cause being shown to the Commission why the granting of a license would not be in accordance with the provisions of this chapter, the Commission shall thereupon issue a license to the applicant. For all other purposes of this chapter, a construction permit is deemed to be a 'license.'"

It is clear from the face of this statute—and all parties agree—that Congress contemplated a step-by-step procedure. First an applicant would have to get a construction permit, then he would have to construct his facility,

and then he would have to ask the Commission to grant him a license to operate the facility. This procedure is described in its general outlines in Marks and Trowbridge, Framework for Atomic Industry, 76–77 (1955). See also Green, The Law of Reactor Safety, 12 Vand. L. Rev. 112, 121–127 (1958). The second step of the procedure, the application for and granting of an operating license, is governed by § 182a, 42 U. S. C. § 2232 (a). That provision reads, in pertinent part:

> "In connection with applications for licenses to operate production or utilization facilities, the applicant shall state such technical specifications . . . and such other information as the Commission may, by rule or regulation, deem necessary in order to enable it to find that the utilization or production of special nuclear material will be in accord with the common defense and security and will provide adequate protection for the health and safety of the public."

It is clear from this provision that before licensing the operation of PRDC's reactor, the AEC will have to make a positive finding that operation of the facility will "provide adequate protection for the health and safety of the public." What is not clear, and what is at the center of the controversy in this case, is whether the Commission must also have made such a finding when it issued PRDC's construction permit. There is nothing on the face of either § 182 or § 185 which tells us what safety findings must be made before this preliminary step is taken. We know, however, from § 104b that some such finding must be made. For enlightenment on the nature of this finding, both parties urge us to examine the Commission's regulations, and accordingly we proceed to do so.

The crucial regulation for our purposes is the Commission's regulation 50.35, 10 CFR § 50.35:

> "Section 50.35. *Extended time for providing technical information.* Where, because of the nature of

> a proposed project, an applicant is not in a position to supply initially all of the technical information otherwise required to complete the application, he shall indicate the reason, the items or kinds of information omitted, and the approximate times when such data will be produced. If the Commission is satisfied that it has information sufficient to provide reasonable assurance that a facility of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public and that the omitted information will be supplied, it may process the application and issue a construction permit on a provisional basis without the omitted information subject to its later production and an evaluation by the Commission that the final design provides reasonable assurance that the health and safety of the public will not be endangered."

This regulation, obviously, elaborates upon and describes in fuller detail the step-by-step licensing procedure contemplated by §§ 182 and 185. It states, pursuant to the authority conferred by §§ 104b and 161i (3), what safety findings shall be required at each stage of the proceeding. There is general agreement that the second safety finding referred to, "that the final design provides reasonable assurance that the health and safety of the public will not be endangered," comports with the requirements of § 182 concerning the issuance of a license to operate. There is also agreement that the regulation's first required safety finding, "that [the AEC] has information sufficient to provide reasonable assurance that a facility of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public," is a valid exercise of the rule-making power conferred upon the AEC by statute, and

requires that some finding as to safety of operation be made even before a provisional construction permit is granted. The question is whether that first finding must be backed up with as much conviction as to the safety of the final design of the specific reactor in operation as the second, final finding must be.

We think the great weight of the argument supports the position taken by PRDC and by the Commission, that Reg. 50.35 permits the Commission to defer a definitive safety finding until operation is actually licensed. The words of the regulation themselves certainly lean strongly in that direction. The first finding is to be made, by definition, on the basis of incomplete information, and concerns only the "general type" of reactor proposed. The second finding is phrased unequivocally in terms of "reasonable assurance," while the first speaks more tentatively of "information sufficient to provide reasonable assurance." The Commission, furthermore, had good reason to make this distinction. For nuclear reactors are fast-developing and fast-changing. What is up to date now may not, probably will not, be as acceptable tomorrow. Problems which seem insuperable now may be solved tomorrow, perhaps in the very process of construction itself. We see no reason why we should not accord to the Commission's interpretation of its own regulation and governing statute that respect which is customarily given to a practical administrative construction of a disputed provision. Particularly is this respect due, when the administrative practice at stake "involves a contemporaneous construction of a statute by the men charged with the responsibility of setting its machinery in motion, of making the parts work efficiently and smoothly while they are yet untried and new." *Norwegian Nitrogen Products Co.* v. *United States*, 288 U. S. 294, 315 (1933). And finally, and perhaps demanding particular weight, this construction has time and again been brought to the attention of

the Joint Committee of Congress on Atomic Energy, which under § 202 of the Act, 42 U. S. C. § 2252, has a special duty during each session of Congress "to conduct hearings in either open or executive session for the purpose of receiving information concerning the development, growth, and state of the atomic energy industry," and to oversee the operations of the AEC. See, *e. g.*, Hearings on Development, Growth, and State of the Atomic Energy Industry, 84th Cong., 2d Sess., p. 106 (1956); Hearings on Development, etc., 85th Cong., 2d Sess., pp. 119–121 (1958); Hearings on Development, etc., 86th Cong., 2d Sess., pp. 103–109, 677–678 (1960); Hearings on Development, etc., 87th Cong., 1st Sess., pp. 29–32 (1961); Hearings on Governmental Indemnity for Private Licensees and AEC Contractors Against Reactor Hazards, 84th Cong., 2d Sess., pp. 62–65 (1956); A Study of AEC Procedures and Organization in the Licensing of Reactor Facilities, 85th Cong., 1st Sess., pp. 11–14, 100–108 (Joint Comm. Print 1957). No change in this procedure has ever been suggested by the Committee, although it has on occasion been critical of other aspects of the PRDC proceedings not before us. It may often be shaky business to attribute significance to the inaction of Congress, but under these circumstances, and considering especially the peculiar responsibility and place of the Joint Committee on Atomic Energy in the statutory scheme, we think it fair to read this history as a *de facto* acquiescence in and ratification of the Commission's licensing procedure by Congress. Cf., *e. g.*, *Ivanhoe Irrig. Dist.* v. *McCracken*, 357 U. S. 275, 292–294 (1957); *Brooks* v. *Dewar*, 313 U. S. 354, 360–361 (1941). This same procedure has been used in each of the nine instances in which the Commission has granted a provisional construction permit for a developmental nuclear power reactor, *e. g.*, *Yankee Atomic Elec. Co.*, CPPR–5 (AEC 1957), and we hold that it was properly used in this case.

It is plain that the statute and regulations, as so construed and applied, were complied with fully. The Commission did not, as respondents' argument seems at times to suggest, find merely that the construction of the reactor would present no safety problem. The Commission's opinion and findings clearly were deeply concerned about the prospective safety of operation of the proposed reactor. Admitting that on the basis of the facts before it it was unable to make a definitive finding of safety, the Commission nevertheless found—and respondents do not deny that the finding was supported by substantial evidence—that it had information sufficient to provide reasonable assurance that the general type of reactor proposed could be operated without undue risk to the health and safety of the public. Its Finding 22, which we have quoted, was in the very words of Reg. 50.35, except for the insertion of the phrase, "for the purposes of a provisional construction permit." This phrase was merely declaratory of the nature of the proceeding before the Commission, and in no way denigrated the finding as to safety of operation.

Respondents contend nevertheless that their construction of the statute is compelled by the legislative history. Since the Court of Appeals relied heavily on this history, we have studied it carefully. Two incidents are cited in particular. First, the Joint Committee stated in its report on the bill which became the Atomic Energy Act of 1954, and which when reported contained §§ 182 and 185 in substantially their present shape, that "[s]ection 185 . . . requires the issuance of a license if the construction is carried out in accordance with the terms of the construction permit." S. Rep. No. 1699, 83d Cong., 2d Sess., p. 28 (1954); H. R. Rep. No. 2181, 83d Cong., 2d Sess., p. 28 (1954). The best we can say about this statement, with all deference, is that it must have been inadvertent. Witnesses who appeared before the Joint

Committee at the hearings on the bill had made the very complaint that under the words of the bill as proposed a company might invest large sums in construction of a reactor, and then be denied the right to operate it. This situation, they claimed, was unfair, and would substantially discourage the private investment in the field of atomic power which it was one of the bill's major purposes to stimulate. See Hearings before the Joint Committee on Atomic Energy on the Bill to Amend the Atomic Energy Act of 1946, 83d Cong., 2d Sess., Pt. I., pp. 113, 119 (statement of Paul W. McQuillen, representing the Dow Chemical-Detroit Edison and Associates atomic power development project, predecessors of PRDC); pp. 226–227 (statement of E. H. Dixon, chairman of the Committee on Atomic Power of the Edison Electric Institute and president of Middle-South Utilities, Inc.); p. 417 (statement of the Special Committee on Atomic Energy of the Association of the Bar of the City of New York). In spite of these pleas, however, the bill was unchanged. Industry spokesmen renewed the argument the next year when they sought unsuccessfully to have § 185 amended. Hearings on Development, etc., 84th Cong., 1st Sess., pp. 258, 261 (1955). Even a glance at § 185 suffices to show that issuance of a construction permit does not make automatic the later issuance of a license to operate. For that section sets forth three conditions, in addition to the completion of the construction, which must be met before an operating license is granted: (1) filing of any additional information necessary to bring the application up to date—information which will necessarily in this case include detailed safety data concerning the final design of petitioner's reactor; (2) a finding that the reactor will operate in accordance with the act and regulations—*i. e.*, that the safety and health of the public will be adequately protected—and with the construction per-

mit itself, which is expressly conditioned upon a full investigation and finding of safety before operation is permitted; and (3) the absence of any good cause why the granting of a license to operate would not be in accordance with the Act—*e. g.*, a showing by respondent unions, who will have full rights to appear and contest the issuance of an operating license, that the reactor may not be reasonably safe.

Respondents rely more heavily on another event during the debates on this bill on the floor of the Senate. Senator Humphrey, an opponent of the bill, expressed a desire that it be made clear that "the construction permit is equivalent to a license," and that "the revised section 182 on license application . . . appl[ies] directly to construction permits." 100 Cong. Rec. 11566 (July 26, 1954). Senator Hickenlooper, floor manager of the bill and the ranking Senate member of the Joint Committee on Atomic Energy, indicated that he agreed with this construction of §§ 182 and 185. Senator Humphrey wanted these matters made clear because he feared that otherwise a construction permit could be easily obtained and substantial investment made in construction, and then the Commission would feel obliged, perhaps under pressure, to issue an operating license in order that this investment should not go to waste. The language used in the exchange between Senators Humphrey and Hickenlooper is susceptible, if read broadly and out of context, of the construction which respondents attribute to it, namely, that no § 185 construction permit may be issued unless the Commission has made the same safety-of-operation finding which it must make under § 182a before allowing actual operation. But the context of the exchange makes it clear that no such implication was intended by the participants. Senator Humphrey's statements were made during the consideration of an amendment which he

had himself proposed on July 16. This amendment would have added the following clause to the end of § 185:

> "and no construction permit shall be issued until after the completion of the procedures established by section 182 for the consideration of applications for licenses under this Act."

Upon being assured by Senator Hickenlooper that an earlier amendment which Senator Hickenlooper himself had offered to § 189 took care of the problem, Senator Humphrey withdrew his proposal. This amendment to § 189, which was adopted, was concerned solely with hearings and judicial review. Plainly Senator Humphrey's concern was not with the substantive safety findings necessary to the issuance of a construction permit, but rather with the procedural safeguards with which that issuance should, in his opinion, be surrounded. The reference to the application of § 182 to construction permits was made not with § 182a in mind—that subsection sets out the substantive safety standard for the issuance of an operating license—but rather with a view to the application of § 182b, about which Senator Humphrey particularly asked Senator Hickenlooper during the exchange on the floor referred to, and which merely provides that notice of a license application must be published and given to any appropriate regulatory agencies, a procedural requirement which was fully satisfied in this case. This interpretation of the meaning of Senator Humphrey's remarks is borne out by a statement of Representative Holifield, who, together with Representative Price, had dissented from the favorable report of the Joint Committee, precisely because, *inter alia*, under the bill as reported a construction permit did not have to be preceded by the same *procedures* as an operating license. See S. Rep. No. 1699, 83d Cong., 2d Sess., p. 123 (1954); H. R. Rep. No. 2181, 83d Cong., 2d Sess., p. 123 (1954). Repre-

sentative Price wanted the same amendment added to § 185 which Senator Humphrey proposed, and he characterized this amendment as necessary to ensure "that the same procedural safeguards in the case of licenses be applied to construction permits." 100 Cong. Rec. 10398 (July 19, 1954). We think, therefore, that Senator Humphrey's statement referred only to procedural prerequisites of construction permits, and had nothing to do with the substantive safety considerations which this case involves. If there were any doubt about this matter, the consistent administrative practice, made known to Congress many times and never disturbed by it, would dictate this conclusion.

The Court of Appeals put forward as an alternative basis for its decision the holding that under the law the Commission may not authorize the construction of a reactor near a large population center without "compelling reasons" for doing so, 280 F. 2d, at 651–652, and that no such reasons had been found by the AEC in this case. It is not clear whether respondents have abandoned that contention in this Court, and it is likewise uncertain whether they ever presented it to the Commission, a step which would ordinarily be a prerequisite to its consideration by the Court of Appeals. In any event, the position is without merit. The statute and regulations say nothing about "compelling reasons." Of course Congress (and the Commission too, for that matter) had the problem of safety uppermost in mind, and of course that problem is most acute when a reactor, potentially dangerous, is located near a large city. But the Commission found reasonable assurance, for present purposes, that the reactor could be safely operated at the proposed location, and that is enough to satisfy the requirements of law. The Commission recognized that the site and all its properties are among the most important ingredients of a finding of safety *vel non*. It considered the site along with all

the other relevant data. There is no warrant in the statute for setting aside the Commission's conclusion.

We hold, therefore, that the Court of Appeals erred in setting aside the order of the AEC continuing PRDC's provisional construction permit in effect. We deem it appropriate to add a few words concerning the fears of nuclear disaster which respondents so urgently place before us. The respondents' argument is tantamount to an insistence that the Commission cannot be counted on, when the time comes to make a definitive safety finding, wholly to exclude the consideration that PRDC will have made an enormous investment. The petitioners concede that the Commission is absolutely denied any authority to consider this investment when acting upon an application for a license for operation. PRDC has been on notice long since that it proceeds with construction at its own risk, and that all its funds may go for naught. With its eyes open, PRDC has willingly accepted that risk, however great. No license to operate may be issued to PRDC until a full hazards report has been filed, until the AEC's Advisory Committee on Reactor Safeguards makes a full investigation and public report on safety to the Commission, until the Commission itself, after notice and hearings at which respondents, if they desire, may be heard, has made the safety-of-operation finding required by § 182a and Reg. 50.35, and until the other requirements of § 185 have been met. It may be that an operating license will never be issued. If one is, that will not be the end of the matter. The respondents may have judicial review. Moreover, the Commission's responsibility for supervision of PRDC continues. For, under Reg. 50.57, 10 CFR § 50.57, operation at full power (100,000 electric kilowatts) will not be permitted until several steps of gradually increasing operation have been successfully mastered, with a full public hearing at each step, and no further advance permitted without the AEC's

being fully satisfied that a step-up will meet the high safety standards imposed by law. This is the multi-step scheme which Congress and the Commission have devised to protect the public health and safety. We hold that the actions of the Commission up to now have been within the Congressional authorization. We cannot assume that the Commission will exceed its powers, or that these many safeguards to protect the public interest will not be fully effective.

Accordingly, the judgment is reversed and the cause is remanded to the Court of Appeals for further proceedings consistent with this opinion.

Reversed and remanded.

SUPREME COURT OF THE UNITED STATES

Nos. 315 AND 454.—OCTOBER TERM, 1960.

Power Reactor Development Co., Petitioner, 315 *v.* International Union of Electrical, Radio and Machine Workers, AFL–CIO, et al. United States, et al., Petitioner, 454 *v.* International Union of Electrical, Radio and Machine Workers, AFL–CIO, et al.	On Writs of Certiorari to the United States Court of Appeals for the District of Columbia Circuit.

[June 12, 1961.]

MR. JUSTICE DOUGLAS, with whom MR. JUSTICE BLACK concurs, dissenting.

The only requirement in the Act for a finding that the facilities involved here "will provide adequate protection to the health and safety of the public" is found in § 182 which is headed "License Applications."[1] By the terms of § 185 a construction permit is, apart from the requirements of § 185, "deemed a 'license.'"[2] Section 185 governs applications for construction permits. It has no separate or independent standards for safety, no specific requirement for a finding on "safety." If the facility is finished and will operate "in conformity with" the Act, the license issues "in absence of any good cause being shown to the Commission why the granting of a license would not be in accordance with the provisions of" the

[1] See Appendix to this opinion.

[2] *Ibid.*

Act. As the Committee Report stated, "Section 185 . . . *requires* the issuance of a license if the construction is carried out in accordance with the terms of the construction permit." [3] In other words the finding on "safety," if it is to be made (as it assuredly must be), must be made at the time the construction permit is issued or not at all.

While in the present case the Commission "finds reasonable assurance in the record, for the purposes of this provisional construction permit" that the facility can be operated "without undue risk to the health and safety of the public," it also finds that "It has not been positively established" that a facility of this character "can be *operated* without a credible possibility of releasing significant quantities of fusion products to the environment." The Commission added that there was "reasonable assurance" before the date when the facility went into operation that research and investigation would definitely establish "whether or not the reactor proposed by the Applicant can be so operated."

Plainly these are not findings that the "safety" standards have been met. They presuppose—contrary to the promise of the Act—that "safety" findings can be made *after construction is finished*. But when that point is reached, when millions have been invested, the momentum is on the side of the applicant not on the side of the public. The momentum is not only generated by the desire to salvage an investment. No agency wants to be the architect of a "white elephant." Congress could design an Act that gave a completed structure that momentum. But it is clear to me it did not do so.

When this measure was before the Senate, Senator Humphrey proposed an amendment that read, "no construction permit shall be issued by the Commission until

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[3] 1 Leg. Hist. 1024. (Emphasis added.)

after completion of the procedures established by Section 182 for the consideration of applications for licenses under this act."[4] That amendment would plainly have made the present findings inadequate, for they leave the issue of "safety" wholly in conjecture and unresolved.

Senator Humphrey explained his amendment as follows:[5]

> "The purpose of the amendment when it was prepared was to make sure that the construction of a facility was not permitted prior to the authorization of a license, because had that been done what it would have amounted to would be getting an investment of a substantial amount of capital, which surely would have been prejudicial in terms of the Commission issuing the license. In other words, if the Commission had granted the construction permit for some form of nuclear reactor, and then the question of a license was not fully resolved, surely there would have been considerable pressure, and justifiably so, for the Commission to have authorized the license once it had authorized the permit for construction.
>
> "The chairman of the committee tells me he has modified certain sections by the committee amendments to the bill, of which at that time I was not aware. The chairman indicates to me that under the terms of the bill, as amended, the construction permit is equivalent to a license. In other words, as I understand, under the bill a construction permit cannot be interpreted in any other way than being equal to or a part of the licensing procedure. Is that correct?"

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[4] 3 Leg. Hist. 3759.

[5] *Ibid.*

His question was answered by Senator Hickenlooper who was in charge of the bill:[6]

> "A license and a construction permit are equivalent. They are the same thing, and one cannot operate until the other is granted.
>
> "The same is true with reference to hearings. Therefore, we believe, and we assure the Senator, that the amendment is not essential to the problem which he is attempting to reach."

Senator Humphrey then asked if § 182 applied "directly to construction permits."[7] Senator Hickenlooper replied "Yes."[8] Senator Humphrey accordingly withdrew his amendment.[9]

This legislative history makes clear that the time when the issue of "safety" must be resolved is before the Commission issues a construction permit. The construction given the Act by the Commission (and today approved) is, with all deference, a light-hearted approach to the most awesome, the most deadly, the most dangerous process that man has ever conceived.[10]

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[6] *Ibid.*

[7] *Ibid.*

[8] *Ibid.*

[9] *Ibid.*

[10] See Biological and Environmental Effects of Nuclear War, Summary-Analysis of Hearings, June 22–26, 1959, Joint Committee on Atomic Energy, 86th Cong., 1st Sess.; Fallout From Nuclear Weapons Tests, Summary-Analysis of Hearings, May 5–8, 1959, Joint Committee on Atomic Energy, 86th Cong., 1st Sess.

APPENDIX.

Section 182a provides in relevant part:

"*License Applications.*—

"a. Each application for a license hereunder shall be in writing and shall specifically state such information as the Commission, by rule or regulation, may determine to be necessary to decide such of the technical and financial qualifications of the applicant, the character of the applicant, the citizenship of the applicant, or any other qualifications of the applicant as the Commission may deem appropriate for the license. In connection with applications for licenses to operate production or utilization facilities, the applicant shall state such technical specifications, including information of the amount, kind, and source of special nuclear material required, the place of the use, the specific characteristics of the facility, and such other information as the Commission may, by rule or regulation, deem necessary in order to enable it to find that the utilization or production of special nuclear material will be in accord with the common defense and security and will provide adequate protection to the health and safety of the public. Such technical specifications shall be a part of any license issued."

Section 185 provides:

"*Construction Permits.*—All applicants for licenses to construct or modify production or utilization facilities shall, if the application is otherwise acceptable to the Commission, be initially granted a construction permit. The construction permit shall state the earliest and latest dates for the completion of the construction or modification. Unless the construction or modification of the facility is completed by the completion date, the construction permit shall expire, and all rights thereunder be forfeited, unless upon good cause, the Commission extends the completion date. Upon the completion of the construction or modification of the facility, upon the

filing of any additional information needed to bring the original application up to date, and upon finding that the facility authorized has been constructed and will operate in conformity with the application as amended and in conformity with the provisions of this Act and of the rules and regulations of the Commission, and in the absence of any good cause being shown to the Commission why the granting of a license would not be in accordance with the provisions of this Act, the Commission shall thereupon issue a license to the applicant. For all other purposes of this Act, a construction permit is deemed to be a 'license.'"